SUPREME COURT OF THE UNITED STATES.

OCTOBER TERM, 1914.

No. 3, Original.

THE PEOPLE OF THE STATE OF NEW YORK, COMPLAINANTS,

vs.

STATE OF NEW JERSEY AND PASSAIC VALLEY SEWERAGE COMMISSIONERS, DEFENDANTS.

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VOLUME III.

THE PEOPLE OF THE STATE OF NEW YORK, Complainants,
vs.
STATE OF NEW JERSEY and PASSAIC VALLEY SEWERAGE COMMISSIONERS, Defendants.

2532 Supreme Court of the United States, October Term, 1911.

THE PEOPLE OF THE STATE OF NEW YORK, Complainants,
against
STATE OF NEW JERSEY and PASSAIC VALLEY SEWERAGE COMMISSIONERS, Defendants.

Before James D. Maher, Esq., Commissioner.

CORPORATION COUNSEL'S OFFICE,
NEW YORK CITY, June 26, 1912—10.30 a. m.

Appearances:

Dr. William J. O'Sullivan, Special Counsel for the People of the State of New York, Complainants;
Adrian Riker, Esq., Of Counsel for the Passaic Valley Sewerage Commissioners, Defendants.
Met pursuant to adjournment.

JAMES H. FUERTES, a witness called on behalf of complainants, recalled for further examination, testified as follows:

The Witness: I would like to note a correction in my answer to a question of Mr. Riker's in regard to the data for the population given in Tables 2 and 3, in regard to the basis of those figures, I find that these figures are taken from the basic data in evidence in this case by Mr. Kuichling, and I have compared these figures personally with that data and have found them to be correct.

Mr. Riker: You mean by that you find them to be correctly
2533 stated, a correct copy of the testimony in this case?

The Witness: Yes, sir.

Direct examination by Mr. O'Sullivan (resumed):

Q. Mr. Fuertes, have you made personal observations and studies of the intermixture of waters differing in character when discharged and flowing in open channels?

A. I have, a number of times, observed phenomena such as you mention, and as a result of these observations am led to believe that

the thorough mixture of such waters flowing in open channels is quite difficult to bring about, and is affected by many physical conditions, such as the relative velocities of flow, the configuration of the channels bounding the flowing streams, and the length of time that the intermixing forces are at work. In some instances the mixing or diffusion is very slow. For instance, I have seen the water of the Atlantic Ocean visibly colored by the discharge from the Amazon River, at a distance of over 50 miles from the shore. I have also seen the waters of the end of Cayuga Lake in New York State, discolored for a distance of two or three miles by the flood flows from the creeks entering the lake from the south, and I have observed similar phenomena in the Lake of Geneva, where the River Rhone, entering the lake at its end discolors the water for a distance of one or two miles, the end of the discolored area in all cases being quite sharply marked. Another matter which is quite commonly known by tourists is the manner in which the Rivers Arve and Rhone flow side by side in the same channel for several miles below the Lake of Geneva, from which the Rhone issues, the gray glacial waters of the Arve occupying about half the width of the river, the other half being filled with the clear blue water from the Lake of Geneva, and these flow side by side for a considerable distance with but slight intermixing.

I have also seen the waters of the Carribbean Sea discolored for a distance of from 10 to 15 miles from shore by the waters of the Magdalena River, and last December I had an opportunity of comparing the specific gravity of the waters of the Carribbean
2534 Sea in this vicinity with waters taken from the area discolored by the Magdalena River, and found that the normal sea water carried about 1.658 pounds of salt per cubic foot, while the water that was discolored yellow from the Magdalena River, at a distance of over 10 miles from shore, carried about 1.284 pounds of salt per cubic foot of water, so that the dilution by fresh water of the Magdalena River had reduced the salinity of the water about one-fourth at this distance from shore.

Q. How did you make those determinations?

A. Those determinations were made with an instrument called a salinometer. This is a glass tube loaded with mercury at the bottom, and arranged to float vertically in the water. The upper end of the tube is drawn down to a small diameter, and a scale is placed in that upper portion. Then the depth at which it floats is indicated by the portion of this small tube which sticks up above the surface of the water, and it is arranged and graduated so that in distilled water at a temperature of 60 degrees Fahrenheit the zero mark on the scale is just level with the surface of the water, and, of course, if the water is heavier than distilled water this tube will float not quite so deep and the tube will stick up above the water and you can read directly on the scale the specific gravity of the water. I understand it was made by Mr. Greiner of New York for the Metropolitan Sewerage Commission, and was tested out with standard solutions of salt water, and the scale divided acordinglyy.

Q. Did you make observations of any other instances such as those you have just testified to?

A. Yes. Another striking instance of the slowness with which dispersion takes place in currents of water is afforded by the Gulf Stream which finds its origin in the Gulf of Mexico, and which under the influence of winds and temperature flows northeasterly through the ocean parallel with the Atlantic Coast to lose itself, finally, in the cold waters of the Artic seas to the north of England and Europe.

2535 On a trip to South America last year I took samples of the sea water at intervals of a few hours all the way from New York to the coast of South America at La Guayra in order to observe the salinity of the sea water, and note if there were any material variations in its specific gravity over this course. I have with me the original notes of these observations.

I sailed from New York on the Red "D" Line, steamship "Philadelphia" on October 25, about noon. At 8 P. M., that evening when the log showed 65 miles from Sandy Hook, the temperature of the sea water was 60.5 degrees Fahrenheit, and it contained 1.531 pounds of salt per cubic foot. At 8 A. M. the next morning we were about on the edge of the Gulf Stream, the temperature of the water was 79 degrees and it carried 1.709 pounds of salt per cubic foot, an increase of .18 pound per cubic foot in the salinity. For the next three days the temperature of the water remained about constant, decreasing very slightly, but not significantly, thereafter in the Carribbean Sea. The interesting feature of these observations is that the influence of the fresh water from the Atlantic Seaboard, mainly from the Hudson River, was shown in these observations for at least 65 miles from shore, until the Gulf Stream was entered, and that the Gulf Stream maintained its temperature and its integrity as a homogeneous body of water, so far as its density is concerned, practically from the Straits of Florida to opposite New York.

Another interesting example of the slowness with which the mixing of flowing waters in open channels takes place is seen in the Susquehanna River, in Pennsylvania. For many years I have been engaged by the City of Harrisburg in the carrying out of public works, and have made many observations in connection with this river. Above the City of Harrisburg there are three main branches to the river, the north branch which rises in New York State and flows down into Pennsylvania through the anthracite coal fields; the west branch which rises in the northwestern part of the state in the sandstone plateau and joins the north branch near or just above Sunbury; the Juniata River, which rises in the southern part

2536 of the state and which flows north and east to join the Susquehanna at Clark's Ferry, some 14 miles above Harrisburg. These three main streams each drain territories of different geological formations and of different topographical structure, and as a result of these different conditions the flood waters from the north branch are black with coal dust and culm, the flood waters from the west branch are brownish in color, and the flood waters from the Juniata are yellow, this latter discolorization being acquired from the yellow clay on its watershed. When all three of these watersheds

are contributing flood waters at the same time the Susquehanna River, at Harrisburg, is really three rivers running side by side in the same channel, the black waters of the north branch running down the channel on the east side of the river, the red or brownish waters from the west branch taking the center of the channel, and the yellow waters of the Juniata following the west side of the river. The river at this point is some 4,000 feet in width, and the lines of demarkation are frequently very sharp, so that as you stand upon the bridge looking north up the river you see these three discolored streams coming down, as far as the eye can reach, without mixing. On the accompanying map I have shown the watershed of the Susquehanna River in the State of Pennsylvania and have outlined the watershed of the north branch with black; of the west branch with red and of the Juniata with yellow. It will be observed upon this map that there were three dams across the Susquehanna, above Harrisburg, at the time to which I refer, the first of these dams being located at Clark's Ferry, about 14 miles by river above Harrisburg; the next at Sunbury, about 47 miles above Harrisburg and the next at Nanticoke, a little over 100 miles from Harrisburg by river. The black water which flows down the east side of the Susquehanna River during floods comes from the washing into the river of culm and coal dust from the anthracite regions in the areas indicated by cross lines on the map, and although passing over the dams mentioned does not, during the early part of general floods, get
2537 dispersed across the entire width of the river until after the peak of the flood has passed.

Q. What is that map?

A. I have prepared a map showing the watershed of the Susquehanna River in the State of Pennsylvania, above Harrisburg, outlining with colors the watersheds of these three branches. The watershed of the north branch, which contains the anthracite coal beds is outlined with black, the watershed of the west branch is outlined with red, and the watershed of the Juniata is outlined with yellow. The City of Harrisburg lies about 14 miles down the river from the dam.

Q. Who prepared this map?

A. I prepared that map. It is taken from the Rand-McNally map of the State of Pennsylvania, and the tracing was made in my office.

Mr. O'Sullivan: I offer the map just described by this witness in evidence and ask that it be marked Complainants' Exhibit No. 139 in evidence.

Mr. Riker: The offer is objected to on the ground that a map of the State of Pennsylvania or any part of it is immaterial and irrelevant to this issue.

The Commissioner: Note the objection of counsel for defendants. Received and marked Complainants' Exhibit No. 139.

Marked Complainants' Exhibit No. 139.

Q. What does this diagram show?

A. In connection with some experimental work which was carried on under my direction at the City of Harrisburg, we found that the nature of the turbidity of the water exerted a very considerable influence on the methods we would have to employ for purification, and then we also found that the color or turbidity was an index of its nature.

So, in order to have a record of the color in a more definite way than would be acquired by simply describing it as black or brown or green or yellow, a method that was in use at the time for recording colors of bacterial growths was modified and adopted to determine the colors. This was done by collecting a sample of the
2538 water, placing it in a glass jar on a sheet of white paper in a reflected light and right by the side of this glass jar containing a sample of water placing what we call a color top, which is merely a little top arranged to be run by a dry battery, on which we would put the colored papers expressing the percentages of the areas in each color, and then by rotating the colors on the top match exactly the colors of the waters. Then, the proportions of these different colors were read off from the disk at the top, showing the percentage of white, red and yellow that enters to make up this fuse or composite color shown on the top. There were recorded in that way many observations and I have on this drawing shown some of the determinations that were made for the Susquehanna. Each of these diagrams, of which there are seven, represent the determination of the color mathematically expressed, under the center of the span of the Walnut Street Bridge crossing the Susquehanna at Harrisburg. Samples were collected under the centers of each of these bridge spans, and the color read in this way, for each of the diagrams shown. The diagrams show on the left hand of each a scale of zero to 100 per cent., and the portion of the diagram that is colored, yellow, red, white or black is the percentage shown on the colored top under the center of each span on each of those particular days. Those readings that are shown graphically here are given for all the readings, the actual percentages for each station on this table, which is a blue-print of the original record.

Q. Have you the original record with you now?

A. I have the original record here.

Q. Have you compared this blue-print with the original record?

A. Yes.

Q. How do they compare?

A. Correct in all particulars. The blue-print was made right directly from the original record.

Mr. O'Sullivan: I offer this blue-print made from the original record in evidence, and ask that it be marked Complainants' Exhibit No. 140 in evidence.

2539 Cross-examination by Mr. Riker:

Q. This table refers to the Susquehanna River at Harrisburg?

A. Yes.

Q. Did you do the sampling?

A. I was present when the samples were taken, some of them not all of them. This one of March 1st was there when all these samples were collected.

Q. And the others, you were not present?

A. No, I was not present. They were made by the same men.

Mr. O'Sullivan: Under your direction?

The Witness: Yes. This work was done under my direction.

Q. When you say this work was done under your direction what do you mean?

A. I mean I was in charge of this entire work in every respect. All the men reported to me, and through me they got their instructions of what to do.

Q. Do you know, as a matter of fact, whether they carried them out?

A. I am pretty sure they did.

Q. How do you know?

A. There was no question about it.

Q. There could be no question about it?

A. No, I think not.

Q. Then, the following out of instructions is a matter of automatic mechanical sequence, as to which there can be no question?

A. Well, I think there was no question at all about the collection of these samples at the points indicated.

Q. That is only your belief, is it not?

A. That is my belief.

Q. And what part of these observations relate to sewage?

A. Directly I do not suppose any part relates to sewage, but there is a relation between the black color and the turbidity of this water and sewage discharged into this river.

Q. I suppose there is a relation between sewage and all the other colors?

A. Not to so great an extent as there was to black.

Q. There is a relation however?

A. I would hardly know how to connect it.

Q. There is some relation of pure water to sewage?

2540 A. In a way, if you have the two mixed together.

Q. Is there any part of this table that refers to the sewage discharged into the Susquehanna River at Harrisburg?

A. No.

Mr. Riker: The offer is objected to on the ground that it is incompetent and immaterial to this issue.

The Commissioner: Note the objection of counsel for defendants. Received and marked Complainants' Exhibit No. 140.

Marked Complainants' Exhibit No. 140.

Direct examination by Mr. O'Sullivan (resumed):

Q. Do you include trade waste in the term used by engineers sewage?

A. Why, ordinarily, yes, in this sewage and trade wastes all go together. Class it all as sewage.

By Mr. Riker:

Q. The black color that you observed, was that due to trade wastes?
A. That black color was due to coal.
Q. Do you call that trade waste?
A. Yes, it is washings from the coal mines.

By Mr. O'Sullivan:

Q. Some of the coal mine trade wastes cause very serious preblems, do they not?
A. Yes, in all rivers where the washings from the coal go.
Q. Some acting as precipitants and some acting as coagulants?
A. Yes. We found that to be the case in the black water in the Susquehanna. It was very difficult to handle in the filters because of the formation of the coagulants in the water.

By Mr. Riker:

Q. Is coal dust a polluting substance?
A. It certainly is a polluting substance. In this case it is purifying also.
Q. Inorganic, is it not?
A. Yes.

By Mr. O'Sullivan:

Q. Now, Mr. Fuertes, from the data set forth in Complainants' Exhibit No. 140, did you cause this graphic chart to be designed?
2541 A. That was made in my office from data under my supervision with my assistants.

Mr. O'Sullivan: I offer this chart in evidence and ask that it be marked Complainants' Exhibit No. 141.

Cross-examination by Mr. Riker:

Q. The chart contains a statement of the matters that were in your other table, that is all?
A. The chart contains a graphic statement of the matters shown in that table.
Q. And nothing else?
A. So far as the colors of turbidity are concerned, yes. That is also shown on the table.
Q. It does not show anything except what is on the table?
A. I believe not, except the spans of the bridge, which are referred to on the table as stations so and so.

Mr. Riker: The same objection as to this table.
The Commissioner: Note the objection of counsel for defendants.
Received and marked Complainants' Exhibit No. 141.

Direct examination by Mr. O'Sullivan (resumed):

Q. Mr. Fuertes, what sort of a device did you use in arriving at

these colors that compose the turbidities to determine the percentage of the color?

Mr. Riker: The question is objected to as calling for an answer that is immaterial and irrelevant.

The Commissioner: Note the objection of counsel for defendants.

A. I can best explain the nature of this apparatus by describing it from the apparatus itself.

(Witness produces apparatus.)

One similar to that which is here produced was used.

Q. Describe that apparatus, Mr. Fuertes?

A. I have here two dry cells, ordinary dry cells and a small toy motor, an electric motor, arranged to be driven by the current from these dry cells. The little motor is connected so that its axis stands vertical, and near the top there is a little wooden hub upon
2542 which I place a paper or cardboard disc graduated around the periphery into 100 parts to mark the percentages. Upon this white paper disc I place little circular pieces of colored paper, the colors on the top present being black, white, red and yellow, which are the colors that were used in determining the turbidity of the Susquehanna River water at Harrisburg referred to. The Method of using this, as I described before, was to compare the fused color that results from the rotation of this top, with the sample of water standing in a jar beside it and under the same light. By rotating this disc,—little paper slips were put so that they could slip one inside the other and the percentages of the different colors on the top could be made to vary at will, exposing as much or as little of the edges of any color as desired, and in that way by changing them around the color of the turbidity was matched and then the record was made by reading off the graduated disc the percentage of each color which showed on the top, when under rotation the color matched the color of the water. I have prepared for convenience in showing these four discs, pasting upon them the colors in the percentages shown on the readings of one of the floods here. It is the first one that is shown, that is the flood of March 1. These discs show respectively the color of the turbidity under the first span near Harrisburg, show the color under the fourth span from Harrisburg, and under the seventh span which was next to the island in the river, and under the last span over to the Cumberland side, span 15. These range from black, almost dead black on the Harrisburg side at the time of that flood and that color extended out under the first two spans and under the third to a brownish color under the fourth span, and that color remained practically the same up to the seventh span. There the influence of the Juniata water was beginning to be shown. The water then becomes a muddy yellow, a yellowish brown. The last one, I think, the fifteenth span, represents the straight Juniata water which is a bright yellow. These pieces of paper that I used in recording the color were purchased from the Milton Bradley Company of Boston, so that these

colors can always be reproduced by purchasing the same
2543 paper. They are true to the color.

Q. Mr. Fuertes, have you had submitted to you the various exhibits from No. 1 to 126 in this case?

A. I have.

Q. Have you read the hypothetical question?

A. I have.

Q. Taking all these facts and circumstances of record in this case and the facts observed by you into your full consideration, what in your opinion will be the results of the contemplated discharge from the Passaic Valley Trunk Sewer outlet in Upper New York Bay, in the vicinity of Robbins Reef on the harbor waters and tidal waters of New York Harbor, under present existing conditions and under prospective conditions on or about the year 1940, and during the intervening period between the present year 1912 and the year 1940?

Mr. Riker: The question is objected to for the reason that it does not set forth such matters of fact proved in this cause in such a way that it can be determined whether or not this witness has them under consideration in the reply which he is asked to give to the question, and for the further reason that it has not been shown in this case and is not a matter of evidence what the proposed discharge of the Passaic Valley Sewerage Commissioners' sewer is, upon which he is asking to express an opinion.

The Commissioner: Note the objection of counsel for defendants.

A. In my opinion the contemplated discharge of the Passaic Valley Trunk Sewer outlet in Upper New York Bay in the vicinity of Robbins Reef will have a material effect upon the pollution of the harbor waters of the Upper Bay. I believe that by 1940, or possibly before that time, such a discharge would materially reduce the capacity of the harbor to receive sewage, and probably to such an extent as to give rise to nuisances.

Mr. O'Sullivan: Your witness, Mr. Riker.

Cross-examination by Mr. Riker:

Q. How long have you been connected with the Metropolitan Sewerage Commission?

A. Since November, 1906.

Q. Have you been active in it during that period?

A. Yes.

2544 Q. These various excursions that you made by way of inspection of the harbor waters, did you do anything more on them than simply to inspect them with your eyes and nose?

A. No. They were just merely visual inspections.

Q. Before you made those inspections had you familiarized yourself with the sewers that were discharging into New York Bay?

A. Some of them I knew the locations of before I went, others I did not.

Q. You had taken no special means of acquainting yourself

with the locations and points of discharge and population served by these sewers?

A. Not in all of them, the main sewers, of course, we were very cognizant of.

Q. Where you were cognizant of the sewers and the population served by them, you found conditions such as you had expected, did you not?

A. Yes, sir.

Q. The sewers were all discharging at practically the surface of the water?

A. Yes, they were.

Q. And discharging crude sewage?

A. Discharging crude sewage.

Q. Among other inspections I think you said that during the Hudson-Fulton Celebration you made an inspection of the location of the outlet of the Bronx Valley Sewer?

A. I did.

Q. How long ago was that?

(No answer.)

Q. I will withdraw the question, as you seem to have some difficulty in finding it?

A. I can find the exact date.

Q. Cannot give me the date from memory?

A. From memory, I do not want to give that.

Q. I will withdraw the question then?

A. September 29, 1909, here it is.

Q. Was the Bronx Valley Sewer in operation at the time you made the inspection?

A. No, it was not used.

Q. And since has it been put into operation?

A. That I cannot say. I believe it has, I have not seen it myself.

Q. You have not inspected that?

A. I have not seen it since then.

2545 Q. Do you know how large a population that sewer was designed to serve?

A. A considerable population.

Q. I asked how large?

A. Offhand I could not give you the figures.

Q. Not even approximately?

A. I would have to refresh my memory in regard to that. It is a long time ago. I could not say approximately.

Q. What is the size of that sewer?

A. It is a big sewer.

Q. Do you know what the dimensions are?

A. No, I could not tell you offhand.

Q. Do you know whether it is a combined or separate system?

A. I believe it was intended to be a separate system.

Q. Intended to be?

A. Designed for a separate system. I have no data on the fact,

because I have not looked into that side of it, with data furnished by those people. I do not know.

Q. You do not know about that?

A. No. My recollection is hazy on that. I have known at one time. It is so long ago I cannot remember the details. They all can be found out readily.

Q. You have got no written report on it that you can read?

A. I have none here.

Q. Where does that discharge with reference to the city of New York, and particularly the Borough of Manhattan?

A. It discharges just above the pier at P Mt. St. Vincent.

Q. Above the Borough of Manhattan?

A. Above the Borough of Manhattan, a short distance below Yonkers.

Q. And at what point with reference to the shore line?

A. The plans, as I understand, were to carry the outfall pipe out about 300 feet from the shore.

Q. Do you know whether that has been done?

A. I do not.

Q. You don't know, as a matter of fact, that it has not been done?

A. I do not.

Q. Well, in your opinion, is it better to carry it out 300 feet or discharge it at the surface at the shore line?

A. I think it is better to carry it out.

2546 Q. Well, is the Metropolitan Sewerage Commission's work designed to decrease the pollution of the waters of New York Bay?

A. The Metropolitan Commission is studying that subject with the idea of making recommendations, so as to do it, so as to reduce the pollution wherever it is feasible to do so.

Q. And this was its purpose in 1906, was it?

A. No. The purpose of the commission at first was to report conditions of the waters, not to suggest any remedies.

Q. When did you undertake to suggest any remedies?

A. In 1908.

Q. And that was before this Bronx Valley Sewer was put into operation?

A. Yes.

Q. The result of that operation of that sewer, in your opinion, is to furnish pollution to the waters of the bay of New York?

A. Undoubtedly.

Q. Seriously?

A. Seriously.

Q. Why has not your commission taken some action to stop that?

A. The commission has reported adversely on that proposition to the Mayor.

Q. You know that much about it?

A. Yes, I know that.

Q. Did you take any particular interest in that subject matter?

A. Yes.

Q. And you do not remember now the details or the size of the sewer?

A. No.

Q. Nor the population served?

A. No.

Q. Nor the amount of the discharge?

A. No. Nothing except a remembrance of the general proposition.

Q. You do not, as a matter of fact, know whether the discharge is at the shore line, or, as proposed, at a distance 300 feet out in the water?

A. No, I have not seen it.

Q. You take more interest in the Passaic Valley Project than that?

A. No.

Q. Well, you prepared an elaborate report which you read into the record as to the Passaic Valley sewage, bearing upon it, in this suit, did you not?

A. I do not remember giving any testimony in regard to it.

Q. Have you prepared any report on the Bronx Valley Sewer?

A. The Commission prepared a report.

2547 Q. I did not ask you that. I asked you if you had?

A. No, personally I have not.

Q. In your inspections of the harbor, did you inspect Gowanus Canal?

A. Yes, I have been down there.

Q. When did you make that inspection?

A. I think I was there twice. I could not tell offhand, because they were not made as these others were. I think I was down there in the Gowanus Canal two or three times on my own initiative.

Q. Is there not some relief work being either constructed or operated for the relief of the Gowanus Canal?

A. Yes.

Q. Is it in operation?

A. It is in operation.

Q. Does that result in an effect upon the pollution of the waters of New York Bay?

A. I do not know what the result of that is. I have not been over there to see since that has been put in operation.

Q. When was it put into operation?

A. Sometime last year, I think. I do not know personally.

Q. You have not examined into that at all?

A. Personally I have not.

Q. Did you take any interest in connection with that?

A. I expect to. The commission has been more or less mixed up with that thing. It has been discussed at some of the meetings.

Q. Is the scheme, so far as you understand it, likely to result in further pollution of the waters of New York Bay?

A. It is pretty difficult to say, because the same quantity of sewage coming in is coming in in a different outfall, a different way, and I would hardly like to make a positive statement as to what

the result might be. My impression is that it would be an improvement.

Q. On the waters of the bay itself as distinguished from Gowanus Canal?

A. Possibly not, I could not say as to that, because there is a question of putrefaction comes in there. We do not know just how it is going to work. As it was originally built, the discharge of the sewer caused large sedimentation in Gowanus Canal of sewage matters. The waters there were very foul indeed. Possibly that
2548 will relieve to some extent the pollution of the waters in the outer harbor. I do not know what is going to happen.

Q. Now, I think you testified that you have designed some works for the city of Orange, the city of East Orange, and the town of Montclair in the State of New Jersey?

A. I have not designed any works. I made a report on their sewage problem but I made no plans for their works.

Q. Who did?

A. I understood Mr. Hering and Mr. Gregory have made plans for sewage disposal in those two towns.

Q. Were those plans submitted to you when you made your reports?

A. No, they were made after my report. My report was made first.

Q. You produced that report and had it marked as an exhibit? And it has been marked as an exhibit in this case?

A. Yes, sir.

Q. And in it you have included some estimates of costs?

A. I did.

Q. Were they made without any plans before you?

A. They were made without any detailed plans, yes.

Q. You would distinguish, then, when you say you made plans between detailed plans and plans not in detail?

A. Certainly.

Q. Did you make plans as distinguished from detailed plans?

A. I made a general outline of the scheme showing positions of the sewer to get to the disposal area, and a map showing the position of the disposal area, the land that would be suitable for the purpose of disposal. That was the extent of the plans that were furnished with the report. For my own purposes I had prices to apply for purification works derived from experience on other works without making detail plans. I used prices that would apply, which were sufficiently accurate for the purpose.

Q. That purpose being to show the superior value of the scheme as compared with the Passaic Valley Scheme?

A. It was not made for that purpose.

Q. For what purpose?

A. To show what the cost would be to build and operate works. Another comparison was introduced there to show how the proposition would stand as compared with going into the Passaic Valley proposition.

2549 Q. Having prepared your figures for the purpose of showing what it would cost, the first application was to compare them with the cost of the Passaic Valley Sewerage Plan?

A. Naturally so.

Q. Having been retained for that purpose?

A. Not that I know of. I was retained to report on the sewage of those three towns.

Q. Where do you locate your disposal plant?

A. That was located down in the valley of the Yantecaw River. I do not know whether it ran in Bellville or Bloomfield.

Q. It did not enter into one of those three municipalities that you were making plans for?

A. No.

Q. And did you estimate, including the cost of the land for disposal works?

A. Yes, that was given.

Q. And the damage to the neighboring properties?

A. I do not think anything was included for damages, excepting in the item of right of way.

Q. And the effluent was planned to discharge where?

A. To discharge into the Yantecaw River.

Q. Are you familiar with that river, what is the Yantecaw River?

A. A very small stream.

Q. Fresh water?

A. Fresh water that runs down through the town of Nutley and down into the Passaic River below.

Q. Through a pretty well settled territory?

A. Very well settled; a nice class of residences.

Q. And a comparatively small flow of water?

A. Very small, yes, a small stream.

Q. And you planned to discharge the effluent from these disposal works in that stream at what point above its mouth or outlet?

A. I hardly know how to describe that point except that it is right above the cemetery there, on Chestnut Hill.

Q. At what distance?

A. From its mouth?

Q. Yes, sir.

A. Roughly twelve miles.

Q. And that twelve miles is all pretty well settled in the
2550 character of residences and improvements that you have mentioned?

A. Yes, at least one-half through a very beautiful district, a very nice district.

Q. The specific form of disposal, what did you call that system?

A. The plan proposed was subsidence in Imhoff tanks, and sprinkling filters, with secondary subsidence and sterilization.

Q. Does that conform to the treatment recommended by you?

A. That conforms to the treatment recommended by me.

Q. You have no connection whatever with the Imhoff plant?

A. No connection whatever with the Imhoff patents.

Q. Mr. Hering has, however?

A. I do not know what he has.

Q. Now, what character of effluent are you contemplating from the general plan that you have recommended for this town and these two cities?

A. I recommended an effluent of good quality as to appearance, and an effluent that would be stable, not subject to subsequent putrefaction, an effluent that had been sterilized.

Q. Is it an effluent which will result in the absence in the Yantecaw River of sewage particles coming from the sewage?

A. Practically so. There may be occasional times when there will be some turbidity from it.

Q. And from which there will be no deposits, objectionable deposits in the bed of the stream?

A. Yes.

Q. And in which there will be an absence along the shores of odors due to the putrefaction of organic matters?

A. Yes.

Q. And in which there will be a practical absence of grease or color due to the discharge of the effluent into that stream?

A. I believe in that case there will be no color, because I believe there can be no trade waste.

Q. Grease?

A. Grease I think will be pretty well eliminated.

Q. Then, there will be a practical absence of grease or color due to the discharge of this effluent into the stream?

A. I think so.

Q. You anticipate there will be no injury to the public health occasioned by the discharge of the effluent into the stream?

A. I think there will be none, no.

2551 Q. And there will be no injurious effect from the effluent, in your opinion, upon property situated on the banks of the stream?

A. There should be none, no.

Q. And there will be an absence of reduction in dissolved oxygen in the waters of the Yantecaw River?

A. There should be none.

Q. How does your effluent differ from the effluent that is stipulated for in the contract between the United States and the State of New Jersey? and the Passaic Valley Sewerage Commissioners?

A. Referring to the stipulations, as to the quality of the effluents I think the two would be very much alike.

Q. Now, is that the contemplated discharge upon which you based your testimony in answer to the hypothetical question which was submitted to you?

A. No.

Q. That was not?

A. That was not.

Q. Well, now, assuming that to be the contemplated discharge from the Passaic Valley Sewerage Commissioners' sewer, discharged as Robbins Reef, under the conditions which are mentioned in this

stipulation as the depth and dispersion area, what will your answer be to the hypothetical question?

A. You mean, as I understand that, in case the effluent from the Passaic Valley Sewer were to be of the quality stipulated for the discharge from the Montclair, Orange and East Orange sewer, but discharged at a greater depth, at many places under the harbor, as is specified here, then what would be my answer to the hypothetical question.

Q. Bearing in mind that you said that that effluent as stipulated did not differ materially from the one that is stipulated for and described in this stipulation?

A. Yes. I think in that case there would be practically very little damage done.

Q. You think that the discharge in that way at that point would be greater in degree than the discharge of the effluent from your proposed works for Montclair, Orange and East Orange into the waters of the Yantecaw River, flowing through a territory of twelve miles?

A. I believe that the discharge of the sewage as stipulated
2552 here from the plant described in the first part of this stipulation would be less desirable in the harbor than the discharge of the effluent in the Yantecaw River.

Q. That, Mr. Fuertes, is not the question. The question is, Is the discharge of the effluent as described in the stipulation——

A. The quality described here?

Q. Yes.

A. I think there would be no objection to it, if you could produce an effluent like that.

Q. There has been read into this record under objection a table that you designated I think as Table No. 1?

A. Table No. 1, yes.

Q. Have you your notes there before you?

A. Yes.

Q. Table No. 1 that has been read in deals with populations entirely, does it not?

A. It does.

Q. And so far as it purports to be actual populations, you have taken them from the testimony that you understand has been given by another witness in this case?

A. I have.

Q. And it is not the result of your own work?

A. Only so far as compiling them here from data put in evidence by another witness.

Q. The estimates of population, were those made by you?

A. No.

Q. That was also simply a restatement of what you understood had been testified to by another witness in this case?

A. That was the case.

Q. Table No. 2 which has been read in under objection is of the same type?

A. Of the same nature.

Q. Made in the same way?
A. Made in the same way.
Q. Table No. 3, which has been read into the record under objection, is based in part upon these populations which are stated in Tables 1 and 2?
A. It is.
Q. What other element or factor is involved?
A. The tidal flows out of Newark Bay, and through the Kill van Kull and the Arthur Kill, and the tidal flows out of the Upper Bay through the Narrows, as put in through Mr. Parsons' testimony.
2553 Q. You have not attempted to determine these tidal flows?
A. No, personally I had nothing to do with it.
Q. You never made any part of the observations upon which those determinations are based?
A. No.
Q. Do you know whether they are correct or not?
A. Further than that they check up approximately with those made by the Government, which are matters of record, and published.
Q. Is there any other point of tidal outflow for the waters of New York Bay than the Narrows?
A. There is.
Q. Where is that?
A. Out through the East River into Lond Island Sound.
Q. Is that included in this?
A. No.
Q. Why not?
A. Mainly for the reason that the inflow and outflow is relatively small as compared with the Narrows.
Q. Have you ever determined it?
A. I have not.
Q. Has anybody so far as you know?
A. It has been estimated.
Q. By whom?
A. It has been estimated by the United States Coast and Geodetic Survey and by Mr. Parsons.
Q. He has taken no observations, that you know of, to determine it?
A. I do not think it can be determined accurately. The indications are there is a slight flow towards the ocean through the Narrows. I do not know how you can prove it.
Q. At what point has the tidal outflow from Newark Bay been determined?
A. The figures that are here given were taken, I believe, opposite New Brighton, a section across there. The data stated are used here.
Q. Well, now, with reference to the Lower shore of Newark Bay, where is New Brighton?
A. On the Staten Island shore.

Q. On the Staten Island shore of Newark Bay?

A. No, the Staten Island shore of the Kill van Kull, the measurements made at the Kill van Kull, through which Newark Bay discharges most of its waters.

Q. And that is the only point at which the determination was made?

A. At these figures, yes.

2554 Q. Do these figures contain, or do they not contain, any allowance for discharge through the Arthur Kill?

A. Yes, the figures that were used for determining the outflow from the bay, as given here, are modified from the actual guaging of the Kill van Kull, and I assume that 84 per cent. of the discharge from Newark Bay goes through the Kill van Kull, and 16 per cent. through the Arthur Kill.

Q. Why was not some such correction made for the tidal outflow from New York Bay by reason of the outflow through the East River?

A. Well, I considered that there was practically no discharge out that way. The evidence is that it is the other way. What goes out comes back again. There is a discharge from Long Island Sound through the Narrows rather than from the harbor into Long Island Sound, so I could not make any allowance.

Q. So, as a matter of fact, you do not think there is any outflow from the East River except through New York Bay?

A. Yes, practicaly so. What is discharged into the end of Long Island Sound comes back again, oscillates back and forth from Long Island Sound into the harbor.

Q. Now, having determined the outflow from the Newark Bay and the outflow from New York Bay, you have made a diagram which you have produced here. It is marked Complainants' Exhibit No. 138. Will you let me have that diagram?

(Counsel examines diagram.)

Q. This table, is it based partly upon present conditions?

A. The diagram?

Q. Yes, the diagram, Complainants' Exhibit No. 138. Your diagram relates in part to the present conditions?

A. Yes, the diagrams are made up from this table here showing present and future conditions, 1910 and 1940 populations.

Q. Well, I ask you if they refer to present conditions?

A. The first diagram—I do not know that it refers to present conditions either, in the sense that you mean, because a large part of the sewage from the New Jersey territory goes into the Pas-

2555 saic River, and is somewhat changed in character before it gets into Newark Bay. These diagrams are simply indications of the population ratio to flow of tidal water out of the bay, under present conditions of population and flow. That is, assuming that the sewage from these populations gets into the bay in relatively fresh condition not in an advanced state of decomposition in each case. A comparison of New York and New Jersey was made on the

same basis in that way. They do not refer identically to present conditions, because there are very few discharges around here that are perfectly fresh. It is all in a more or less state of decomposition.

Q. The diagram, then, except as to population, which has been furnished to you by another witness in this case, applies to the present sewage flow. Where did you get that flow?

A. No question of sewage flow entered into my diagram. That was for the population, the ratio to the flow.

Q. Then, what other fact is in this diagram?

A. This diagram contains a plotting of the data given in Table 6, arranged so as to show the flows as per cubic foot per second per thousand people that would result in the creation of a nuisance. The flows which might or might not result in a nuisance, and flows which would not result in a nuisance. That is additional data and is shown by colored areas, blue, red and brown, across the diagrams.

Q. But what I am trying to get into my own mind is how much of fact is represented by these diagrams, proved facts in the case?

A. The population and the tidal flows.

Q. The populations and the tidal flows are the two facts, and the other conditions which are involved in this diagram are hypothetical?

A. They are assumptions.

Q. Hypothetical, are they hypothetical?

A. I should hardly say they were hypothetical.

Q. You distinguish between an assumption and a hypothesis?

Now Mr. Fuertes, as compared with the present method of
2556 discharge of sewage into the waters tributary to Newark Bay, is the assumption upon which you have made up your tables and diagrams more favorable to good results than the existing ones or not?

A. I believe they are for the reason that the stale sewage will make a more rapid draft on the oxygen of the waters of the bay than fresh sewage would. This is based upon getting the sewage in a relatively fresh condition, and some of that matter would be carried out of the bay by tidal action before it would have a chance to putrefy, whereas at the present time you get putrefaction in the Passaic River.

Q. And the same assumption as to New York Bay?

A. I believe so. Some of the sewers of New York have very septic sewage.

Q. Where are you now assuming the point of discharge of the sewage from these different areas to be in the tables?

A. No assumption was made as to any particular point. No local treatment in that respect.

Q. Is there, in your opinion, any point that is the most favorable for the discharge of the sewage of these areas in these waters?

A. The question is pretty broad. Pretty hard to answer generally. In order to have the conditions which are represented on these diagrams it would be desirable or necessary rather, to have

the sewage pretty well dispersed through the water and not subject to subsidence or detention, that sort of thing, which causes deposits and putrefaction. In that case the conditions will be worse than are indicated here. This is on the assumption that it is possible to get deflection of the sewage through the water either in one or multiple outlets. Any way of getting the sewage discharged into the water and getting it pretty well mixed.

Q. In respect to depth, what would you say was the desirable discharge of sewage for the best results?

A. I think, as a general proposition, a discharge in deep water, as deep under the surface as you can get it. Where conditions make it possible.

Q. And with reference to the surface of the water you think it better to discharge the sewage at the center of the area
2557 or on the edges of the area of the water?

A. Assuming a surface discharge?

Q. No, assuming now a discharge below the surface.

A. I should say that in almost every instance it was better to discharge your sewage away from the shores.

Q. And, as near as possible to the central point of the area of water to receive the sewage?

A. Not necessarily, but in some point where the currents and other conditions would be such as to favor dispersion.

Q. Dispersion being the object in view?

A. Dispersion being the object in view.

Q. Is not that likely to be helped by the discharge of sewage at a depth, and as near the center of the body of water, currents, and other influences being equal?

A. Yes, if you mean by center, of course, the center of action of the currents.

Q. And with reference to the Upper Bay, is or is not that point in your opinion pretty near Robbins Reef?

A. For a central discharge that is a pretty fair point. I do not know whether it is the best.

Q. But you think it is a pretty fair point?

A. I think that is a pretty fair point.

Q. And at a depth of 40 feet is a pretty fair depth?

A. That is a good depth.

Q. And on the edge of the channel there is a pretty good place so far as general dispersion is concerned?

A. Yes.

Q. Now, taking it in a general way, Mr. Fuertes, is the sewage that is assumed finally in Newark Bay discharged into the tributary waters pretty much as the sewage that is assumed in the Upper Bay is discharged into its tributary waters?

A. What do you mean by "tributary waters." Tributary waters to the bay?

Q. Yes.

A. I should say there was a very decided similarity in the method, which method is to get it to the water as quickly as possible.

Q. And in the case of Newark Bay, however, you are familiar with the lay of the land there, are you?

2558 A. Yes.

Q. And the course of the Passaic River?

A. Yes.

Q. And the fact that for considerable distances below the outfalls of the sewer there is a sluggish current comparatively?

A. Yes.

Q. Does or does not that form a species of septic basin, for the sewage of the Passaic River?

A. Undoubtedly does.

Q. The same conditions exist in the Hackensack from its mouth for some distance up?

A. Yes. There is not as much sewage in there, but the same conditions generally.

Q. So, taking these things into consideration, comparing them in a general way, if you can, with the sewage discharged which finds its way into the Upper Bay, which do you think is more likely to be seriously polluted by the character of the discharge?

A. New York Bay is so large and its shore along it so diversified that it is pretty hard to make a comparison, but we have practically similar conditions in Newtown Creek. In the Gowanus Canal, the Harlem River, we have somewhat similar conditions to Newark Bay with respect to the Hackensack and Passaic Rivers.

Q. But the whole discharge reaches Newark Bay subject practically to the conditions which exist in the Gowanus Canal and Newtown Creek?

A. No, because a pretty large part of the sewage in Newark Bay goes into the bay in a relatively fresh condition from the pumping station on the meadows. Just what amount of it I do not know, but some millions of gallons a day, I believe. We have some fresh and some septic sewage discharged into the bay.

Q. You do not think you can make a comparison?

A. For instance, the whole East River at times is almost in a septic condition from Ward's Island to South Brooklyn. Nothing but fresh sewage.

Q. It has been so for a good many years?

A. My observation goes back four or five years.

Q. Is that true of the Hudson River above its mouth, for a good distance up?

A. Not anything like as bad a condition as the East River, the part that I mentioned.

2559 Q. Have you familiarized yourself with the oxygen determinations at the mouths of these two Rivers?

A. The Hackensack?

Q. No, the East River and the Hudson?

A. In a way I have been familiar with them all along.

Q. They show about the same thing, as you remember it, in the way of oxygen exhaustion?

A. Approximately so.

Q. Then at the lower end both are practically open sewers?

A. No, because the bad section of the East River is near Blackwell's Island. That is the worse section, from the north end of Blackwell's Island to the Harlem.

Q. Is not the mouth of the East River as bad?

A. No, the upper end. It comes largely from the 110th street sewer, and *the* discharges into the Harlem River.

Q. Do you know what the determinations of dissolved oxygen were in the Narrows?

A. I have seen the figures, I could not repeat them from memory.

Q. I show you Complainants' Exhibit No. 133, Mr. Fuertes, and ask you whether you have seen that before and examined it?

A. Yes, I have seen that before.

Q. Have you had anything to do with the determination of these averages of dissolved oxygen?

A. No, personally I had nothing to do with it.

Q. But, assuming them to be correct, Mr. Fuertes, and comparing them with your diagram No. 138, how do you explain the fact that at the Narrows the determination is 79 per cent. and at the mouth of Newark Bay it is 64 per cent.?

A. The dissolved oxygen figures which are given on here are averages at the cross-sections taken in the Autumn of 1911. They are not minimum conditions. They are not the ebb and the flood. They are the average. On flood flow when the fresh water comes in from the sea it brings in a flow of oxygen that brings the average up.

Q. That average is that in both cases, is it not?

A. These figures in my diagram refer to ebb tides. They refer to the flow on the ebb tide.

Q. Then, your diagram, Complainants' Exhibit No. 138, is
2560 only a determination of estimated relative pollution in those two bays on the ebb tide, is it?

A. That is right, yes.

Q. And does not represent the average pollution of the two waters?

A. No. It represents the ratio of populations discharging sewage into these waters as compared with the flows from the two bays, the conditions being based on the same data in each case.

Q. Now, taking the middle diagram on Complainants' Exhibit No. 138, which is based on the hypothesis that the Passic Valley sewage would be discharged into Upper New York Bay. Am I right about that?

A. That is correct. The sewage from the Passaic Valley District would be diverted into New York Harbor.

Q. In what condition?

A. In practically fresh condition. All the diagrams are based on that hypothesis.

Q. Is not that hypothesis an illusory one under the conditions?

A. I believe it would be in both cases.

Q. You would not expect to discharge the sewage of that territory at that distance in a substantially fresh condition?

A. No, that could not be done, but whatever condition of pollu-

tion would result from the discharge would be worse than shown on here for both waters.

Q. And that is assuming that the sewage is stale and crude, is it not?

A. Yes, stale and crude.

Q. It is not based upon the effluent to be produced by the processes or means that are described in the stipulation between the United States and the State of New Jersey and Passaic Valley Sewerage Commissioners?

A. No, that was not considered in making the diagram. Simply a comparative statement showing the relative pollution on these assumptions in both cases.

Q. Now, Mr. Fuertes, still referring to this middle diagram, Complainants' Exhibit No. 138, particularly with reference to the part colored green and marked Newark Bay, the left hand vertical line represents your estimated condition for 1910 on the basis of that population?

A. Yes.

Q. Upon the assumption that the sewage discharging into that bay would be discharged into New York Bay?

2561 A. No, just the sewage from the Passaic Valley District would be diverted over but the sewage from the other New Jersey districts that gets into Newark Bay would still go in there. Simply diverting the Passaic Valley sewage into New York Harbor.

Q. That includes the sewage that is discharged in the pumping station in Newark directly into the bay?

A. No.

Q. You did not contemplate that?

A. Let me think a second on that. It includes whatever was intended to have been taken in the Passaic Valley proposition. These are made up from the populations assumed to be taken.

Q. You do not know?

A. I do not know whether that is included or not.

Q. That goes directly into Newark Bay, does it not?

A. Yes.

Q. And if that is contemplated to be included in the discharge from the Passaic Valley Sewer into New York Bay, that is eliminated from the discharge into Newark Bay?

A. Whatever populations were given there would show in these figures. If that Newark sewage were intended to have been taken out in the Passaic Valley proposition that would be eliminated in this.

Q. Now, the right hand vertical line, Mr. Fuertes, what does that represent?

A. On the Newark Bay diagram?

Q. Yes.

A. That represents the ratio of tidal flow out of the bay to the population, the estimate of population for 1940.

Q. And with reference to sewage what does it indicate?

A. It represents that the sewage from that population, the 1940 population, would then bear the ratio per square foot per thousand

people per second of about 7 cubic feet of tidal flow per thousand population.

Q. The conditions have gotten down pretty near to the indefinite point?

A. Down near the line.

Q. Where did you get the population from to reduce it from practically 20 1/4 down to 7 in these thirty years?

A. That is just the difference in the estimated population in 1940.

Q. What populations?

A. Populations tributary to Newark Bay, after deducting the population of the Passaic Valley.

2562 Q. Where are they shown in the tables?

A. In Table 1 the total population for 1910 tributary to Newark Bay is given at the bottom of the table, 1,002,863. The population of the Passaic Valley Sewerage District for that year is shown in that column as 734,396, in Table 1. The difference between those two is 268,467, representing the population discharging sewage into Newark Bay outside of the Passaic Valley Sewerage District. That was 268,467. That shows as the population of 1910 in Table 4. Similarly, in the last column of Table 1 the total population tributary to Newark Bay is given as 2,399,660, and the population in 1940 of the Passaic Valley Sewerage District alone is 1,649,420. The difference between those two is 750,240, which is the population given for 1940 discharging sewage into Newark Bay.

Q. Now, the last diagram, or part of the diagram, in Complainants' Exhibit No. 138. What is the process of partial purification that scheme is based on?

A. That diagram is based on the removal of half the organic matter from the sewage. No special method is stated for doing that, not as a practical proposition. The removal of half the organic matter makes the sewage half the normal strength, and doubles the length of the lines in the third diagram over those in the first.

Q. And you have not attempted to specify processes?

A. No.

Q. Nor points at which the processes could be applied?

A. No.

Q. It is just mathematical?

A. Just a demonstration of the ratio of dilution under these different conditions. It is not assumed that the conditions are the actual conditions that will exist at all. That cannot be foretold, but the comparisons are on the same basis in each case and show the relative standing of the two bodies of water as the populations change and the conditions change.

Q. You have not made any diagram showing or attempting to show the conditions of Upper New York Bay, if one-half the organic matter were taken out of the sewage discharged?

2562½ A. That could be done by just doubling the length of these lines. The last diagram, No. 3, for Upper New York Bay. Doubling the length of these lines would give you the ratio. That would put New York Bay in a better condition than Newark

Bay would be under a similar condition, and the more purifying there was done all around the better it would be for everybody.

Q. And that purification of the New York sewage would result in a condition in New York Bay which would be unobjectionable in your opinion?

A. Unobjectionable as to producing nuisances. It might be still objectionable from the point of view of appearance. There might still be greasy slick and all that sort of thing and occasional nuisances around the piers. That would have to be corrected by local treatment. So far as general conditions are concerned it would be all right.

Q. Just what do you understand in your category of nuisances?

A. The difference of what is or what is not a nuisance is largely a personal matter. Some people might consider it objectionable and others might not. From my own point of view I believe that the standard is being raised right along in regard to these matters. People are less likely to put up with bad odors and things which do not appeal to them in an esthetic sense than they were years ago. The standard is being raised right along. I think anything in the shape of bad odors around piers or docks, or in the main channel, resulting from the decomposition of organic matter, particularly animal organic matter should be removed. I believe the appearance on the surface of the water of fecal matter, unbroken up so that it can be recognized as such, bits of paper and garbage and that sort of stuff, could be well classed as a nuisance.

Q. Well, then, would or would not the reduction of the organic matter in New York sewage by 50 per cent eliminate the nuisances, as you have described them, in New York Bay?

A. I believe so, taking out 50 per cent. of the organic matter would probably get out most of the floating stuff, practically all of it. That would give a fairly clean effluent. That, however,
2563 would not necessarily prevent a nuisance from odors, because the 50 per cent. of organic — left in solution might still create a nuisance of itself along the piers and in places where it circulates.

Q. Now, as a practical means of eliminating that unpleasant feature, would or would not discharging the sewage at a distance from the shore and at a considerable depth have an effect?

A. I would always, where feasible, put it as far away as you could get it. The deepest I could get it.

Q. So far as the objectionable features of sewage from the appearance of fecal matter in the water is concerned, is that likely to result more especially from fresh sewage or from sewage that is being carried a distance?

A. The visible pollution, of course, would be more easily recognized in fresh sewage. The odors from stale sewage.

Q. So that the nuisance, as it is determined by sight, is more likely to result from fresh sewage than from stale sewage?

A. Especially if the discharge is deep under the water. Some stale sewage is, however, very offensive to the sight in addition to odors. Take the sewage that comes into Wallabout Bay, that is a septic sewage, very offensive, black, dirty, greasy.

Q. That is caused, is it not, by the fact that the sewage is discharged fresh into the bay and allowed to remain there until it becomes septic without being removed?

A. Not entirely. I believe the sewage as it comes out of the sewer itself smells badly.

Q. How long a sewer is that?

A. It must be eight or ten miles, at least.

Q. Where does it discharge?

A. Wallabout Bay.

Q. At the surface of the water?

A. Yes.

Q. On the shore line?

A. Under the dock. It comes out right at the side of a pier in Wallabout Bay, at the shore line of the bay.

Q. I think you testified that you made an examination of the outfalls of the Boston, Massachusetts, Metropolitan District Sewer?

A. Just an inspection, yes.

Q. Is there any special odor from them?

2564 A. It was not particularly bad, it was not offensive to me. I could notice it distinctly enough.

Q. Do you know, as compared with the proposed Passaic Valley Sewer, what the age of the sewage discharged there is?

A. I presume it is as old as the Passaic Valley would be. Some of the sewers are long and they hold it at the Moon Island plant in storage for some hours.

Q. There is some similarity in that respect to the proposed discharge?

A. I was surprised, however, at the Moon Island plant to see how little odor there was around the settling basin. I expected to find much more than I did. The sewage is not so very rotten.

Q. How do you account for that?

A. I do not know. It must be either diluted or there must be pretty swift velocities.

Q. You have not made study of the velocity of that flow?

A. No, sir.

Q. Do you know the length of the sewer?

A. No. I know in a general way. From a map I know how the sewer runs there in a general way, that is all.

Q. I think you said you made an examination of the outfall of the joint sewer which serves Summit and South Orange and West Orange?

A. Yes.

Q. Do you know the length of that sewer?

A. It is pretty long; it runs way back up there into West Orange.

Q. Does it run up to Summit?

A. Back beyond Summit? No, part of the Summit sewage is pumped over the divide to it.

Q. The western slope of the Summit territory has its sewage pumped?

A. Yes, that goes over.

Q. And that sewage is discharged at the surface?

A. Yes, when I saw it it was discharged considerably above the surface.

Q. It was low tide?

A. Yes, at low tide.

Q. Was the odor there marked?

A. It was marked in the neighborhood of the outfall, yes, a strong musty smell. It is hard to describe it.

Q. Smells are hard to describe?

A. They are. There is no mathematically exact way of describing them. It depends on the effect on the senses.

2565 Q. You have no little device which you could produce showing different colors?

A. No, I cannot measure smells in that way.

Q. Now, these interesting observations that you made in your travels in the separation of different kinds of water, just what connection, in your opinion, have they with the problem of the discharge of sewage from the Passaic Valley Sewer?

A. The discharge of sewage from the Passaic Valley Sewer, or from any other sewer, into a stream where flows take place, of course, at varying rates, and under varying conditions, both as to flow in the sewer and flow in the stream. Where you have a pretty strong current flowing past the mouth of the sewer and discharging sewage into it, the sewage will be carried along ordinarily some distance before it loses its temperature, before the temperature changes and the specific gravity changes and it becomes mixed with the water. It keeps together more or less. The conditions under which that occurs, that mixing of the waters, is very complex and very hard to foretell. Where the quantity of sewage would be large in comparison with the current into which it was discharged the mixing would be very slow. Where the currents are large as compared with the quantity of sewage discharged, then the mixing would be more rapid and more complete.

The bearing which these particular observations have on that problem is simply in showing that under some conditions the mixing of the waters is very slow that it takes usually some outside influence to secure a thorough mixing of the two kinds of water.

Take in the case of the Susquehanna River. There the water comes down on floods from all three watersheds. That is the north branch, the west branch and the Juniata. You have three rivers flowing side by side for many miles, without any mixing in the same channel.

If the flood came from the north branch then the river became black from bank to bank. If the flood comes from the middle branch, and there have been no significant rains on the Juniata or the north branch, then the river will be brown from bank to bank, and so forth.

2566 Q. Well, those conditions in the Susquehanna do not differ materially from those in the Rhone at the mouth, at Lake Geneva?

A. Only that in the Rhone the condition is usually a permanent one, because the Rhone runs out of Lake Geneva clear all the time,

whereas the Arne, which comes from Mount Blanc, brings down the glacial water, and that is the usual current all the year around. On the Susquehanna conditions change, because ordinarily in summer time all three streams give perfectly clear water. Only the floods give these conditions.

Q. You do not mean to be understood as saying that literally the exact conditions in the Rhone are permanent and continuous?

A. They are practically so.

Q. The variation is not so marked?

A. Very less marked.

Q. And you have observed a discharge of sewage into running streams?

A. I have, in a number of instances.

Q. And you have observed the discoloration of the water?

A. In some cases, and in some cases I have seen it disappear quickly. That is a local matter.

Q. But the phenomenon of the appearance of the sewage in the body of water into which it is discharged is not an unusual one?

A. No, it is not.

Q. And does not that furnish just as valuable data for the study of the results of sewage disposal as your Susquehanna River?

A. I think if the data were available for use it would be more valuable. I do not know very much on the subject.

Q. Your Susquehanna River determinations, by this interesting experiment which you have produced here, are valuable, providing the conditions in regard to sewage discharge can be shown to be similar to those under which the phenomena observed by you were produced?

A. Yes.

Q. And unless the conditions are shown to approximate those in the Susquehanna experiments the value would be very small?

2567 A. Of course, the Susquehanna is a very large stream. It is impossible to find conditions where the discharges of sewage would be on such an enormous scale. I took the Susquehanna because we had made experiments and had precise data. Here is a case where it runs at least fourteen miles after passing over a dam without mixing.

Q. It is an exact example of a quite common phenomenon?

A. It is.

Q. And the phenomenon which is observable in connection with the actual subject matter of this inquiry, which is the discharge of sewage?

A. Yes.

Redirect examination by Mr. O'Sullivan:

Q. Mr. Fuertes, in reply to the inquiries of Mr. Riker, relative to Complainants' Exhibit No. 141; are studies such as outlined in this diagram, and in the table that preceded it, valuable in the study of digestion and diffusion of sewage?

A. They are certainly valuable in a study of the diffusion, and of

course of digestion as bearing on the diffusion. Any data that we can get in relation to that matter is of value on this subject.

Q. In measuring the digestive capacity of any body of water is it necessary to be able to determine the degree of diffusion that the sewage entering that body of water would be likely to get?

A. I think it is undoubtedly so, desirable.

Q. Mr. Riker asked you some questions relative to purifying New York City's sewage. Have your commission had remedial measures under your consideration, and suggested to be used for that purpose?

A. It has, yes.

Q. Now, is it a large or a small problem, the purification of that sewage?

A. It is a very large, a very difficult problem, in some cases, some instances, the character is so mixed. The waters into which the discharge takes place vary in capacity to receive sewage. It is a very complicated problem.

Q. Directing your attention to Complainants' Exhibit No. 138, I ask you if the data you find in the compilation or diagrams in that exhibit, whether they were favorable or unfavorable conditions which you have undertaken to delineate in these diagrams?

2568

A. My belief is that the actual conditions would be worse than they are on here, on these diagrams. They would certainly be worse at times.

Q. You assumed the discharge of fresh sewage, did you not?

A. Yes, these are based on the assumption that the sewage will be reasonably fresh.

Q. Do you expect sewage discharged from Robbins Reef from the Passaic Valley Trunk Sewer outfall to be septic or fresh?

A. I should think it would be septic; in a septic condition.

Q. Mr. Riker directed your attention and examined you at some length in regard to Complainants' Exhibit No. 137, being the report furnished by you on sewage disposal of the municipalities of Orange, Montclair and East Orange. I ask you what character of sewage comes from these three municipalities?

A. Those three municipalities are sewered on the separate plan. The sewage is practically household sewage. There is a considerable amount of ground water that gets into the sewers, however, so that it is a weak domestic sewage and a fresh sewage.

Q. Are there trade wastes mixed with it?

A. Practically none so far as I could discover. I should not have dared to recommend a plant of that kind if that sewage had been a septic sewage, and to satisfy myself of that I went to the manhole at the outlet sewer down near the river, took the cover off, where the sewage comes down, and I could detect no signs of odor at all in the sewage. The sewers were short and it would not stay in them very long.

Q. The sewage contemplated to be discharged through the Passaic Valley Trunk Sewer as projected, do you know whether or not that will contain much trade waste?

A. I do not know what regulations have been made in regard to

that under the present plan. There are many industries up and down that valley that produce a great quantity of trade wastes. Whether it is contemplated to discharge them in the sewer, I have no knowledge.

Q. Are some of the trade wastes in the municipalities in the
2569 Passaic Valley highly organic in their character?

A. Yes.

Q. Like what?

A. They are largely woolen mills, in some of those towns.

Q. And there are silk mills?

—. Many silk mills, yes.

Q. And there are breweries?

A. Yes.

Q. That also contains organic waste?

A. Yes.

Q. Are there machine shops?

A. Yes. Machine shops, locomotive works.

Q. Is the spent pickle discharged from machine shops regarded as an objectionable trade waste?

A. Yes, that is. When it comes from the machine shops or industries in which acids are used, it is objectionable. Sulphuric acid is the factor that enters into that.

Q. Mr. Riker directed your attention to Complainants' Exhibit No. 135. Do you believe it is feasible to secure the effluent stipulated for in that stipulation between the United States Gvoernment and the State of New Jersey by the means described in that stipulation?

A. No, I do not.

Mr. O'Sullivan: That is all.

Recross-examination by Mr. Riker:

Q. Do you have any question that it is possible to produce that effluent by additional devices and processes to those specifically described in the stipulation?

A. It is a physical possibility, certainly.

Q. You contemplated that for Orange, Montclair and East Orange?

—. Yes, sir, but different methods from what are stipulated here.

Q. I asked you by other methods than those described in the stipulation?

A. Yes, that is true.

Q. So that there is no physical impossibility at least of producing the effluent that is described in the stipulation?

A. It can be done.

Q. Where do the hat shops of Orange discharge their trade wastes?

A. I do not know.

Q. You do not know that there are hat shops at Orange?

A. Yes.

Q. A great number of them there, are there not?

A. I do not know.

Q. Do you know anything about the hat trade?

A. No, I do not; I am not a hatter.

2570 Q. Would the trade wastes from that be organic or inorganic?

A. Well, from the nature of it it would contain organic matter.

Q. And what about dyes and acids?

A. Dyes also.

Q. How do those get into the discharge?

A. I do not know that there is much there. My impression is very little of it.

Q. You did not make an examination to determine whether there were any?

A. No.

Q. Are there any manufacturing establishments in Montclair?

A. None that I know of.

Q. You do not know of any?

A. No.

Q. Have you ever examined to find out whether there were any?

A. I have inquired.

Q. Are there any in East Orange?

A. None that I know of.

Q. Where does East Orange discharge its sewage, if you know?

A. It discharges it into that joint sewer that comes down.

Q. East Orange?

A. East Orange goes into Millbrook Sewer.

Q. So the sewage of East Orange was not any part of that which you examined?

A. No.

Q. Do you know whether it is a separate system or a combined system?

A. I was told it is separate.

Q. You do not know?

A. No, I do not know. I was told the sewers were separate.

Q. Do you know whether there are any manufactories in East Orange?

A. I believe there are some there.

Q. Did you take those into consideration when you designed your system for the towns of Montclair and East Orange and Orange?

A. I made no special provision in regard to those. I considered it to be a domestic sewage.

Q. You made no variations in your plan for the trade wastes from hat factories?

A. I did not consider in amount it would be sufficient to influence the output.

2571 Q. Don't you know that the largest part of the hat industry of the country is there?

A. No.

Q. Did you ever examine into the question at all?

A. No.

Q. Do you know anything about it then?

A. No. We have got some pretty big hat factories over in Brooklyn.

Q. Now, you said in answer to redirect examination on Complainants' Exhibit No. 138 that the conditions as delineated there were rather favorable than the contrary to conditions in the waters?

A. I think so, yes.

Q. This delineation is entirely confined to the ebb tide, is it not?

A. Yes.

Q. And is the purity of that water greater or less than on the flood tide?

A. On the flood tide, of course, you get the fresh water that comes in. There is a dilution during that period. It takes up sewage that goes out on the ebb.

Q. As to the actual condition of the water this is the most unfavorable condition?

A. No.

Q. When is it more so?

A. A more unfavorable condition would be at the turn of the tire, when there is no motion at all.

Q. At what stage of the ebb were these determinations made?

A. They were not made at any particular stage, they are based on the total ebb flow at the average rate.

Q. Why did you not then make your determinations on the average conditions of the ebb and flow?

A. It did not seem to me that it represented the case fairly.

Q. It would have too favorable an effect for your purposes?

A. I did not consider that at all. I did not think of it in that way.

Q. It would be more favorable than the conditions delineated here?

A. To take the average?

Q. Yes.

A. I do not know how that would be. It would depend on the relative volumes, and I cannot state from memory whether the ebb is greater than the flood. There is a slightly greater dis-
2572 charge on the ebb than the flood due to the fresh water.

Q. Directing your attention to Complainants' Exhibit No. 133, and the determinations of average oxygen contents at the mouth of Newark Bay and at the Narrows, you observe that there is considerable difference between the averages at those two points, do you not?

A. You mean at the Narrows and at the entrance to the Kill van Kull, or do you mean at the lower end of the bay.

Q. The lower end of the bay.

A. Yes, there is a considerable difference.

Q. Indicating a worse condition of the water in Newark Bay at that point than at the Narrows?

A. Yes, these analyses indicate that, as they are shown here.

Q. How do you account for it on the basis of your diagram, Exhibit No. 138?

A. I think I have answered that question before.

Q. I think you did. I think you said it was due to the fact that these figures were based on the ebb tide?

A. Based on the averages on the ebb tide.

Q. That is your only explanation?

A. That is all I see, because I do not know enough of the history of those to say.

Mr. Riker: That is all.

Redirect examination by Mr. O'Sullivan:

Q. Mr. Fuertes, Mr. Riker asked you if you were familiar with the sewages of the Oranges and Montclair. Are you familiar with the character of the sewages of the riparian communities in New Jersey that contribute to the pollution of New York Bay, as to the character of the sewages?

A. The riparian communities, you mean those which are along New York Harbor.

Q. Taking Hoboken, Weehawken, Jersey City?

A. I am to some extent. They are all pretty bad sewages. The sewage of Hoboken, for instance, is pretty bad because there the sewers lie all below, practically tide level. They are nothing but long septic tanks. The tide runs in and out and backs the
2573 sewage up. It stands several hours and then runs out again. I believe this condition happens also in some of the Jersey city sewers, possibly at Bayonne, although I am not so familiar with those.

At 1 P. M., adjourned for noon recess until 2 P. M.

CORPORATION COUNSEL'S OFFICE,
NEW YORK, June 26, 1912—2 o'clock p. m.

OLIN H. LANDRETH, a witness on behalf of Complainants, recalled for further examination, testified as follows:

Direct examination by Mr. O'Sullivan:

Q. Professor Landreth, you have testified previously in this suit?

A. Yes, sir.

Q. Will you state your occupation, the institutions you are connected with, where you received your education and state briefly the various experiences you have had in the pursuit of your profession?

A. I am a civil engineer by profession. Also a professor of civil engineering in Union College. I received my training in several academies and high schools in this state and Pennsylvania. I received my college training at Union College, Schenectady, New York. I began the practice of civil engineering in the year 1870, and after two or three years' practice interrupted it in order to finish my education and take my technical training. I then returned to professional practice in engineering and was soon after that time engaged as Professor of Civil Engineering in Vanderbilt University,

Nashville, Tennessee. I occupied that post for fifteen years, the last seven or eight of which I was dean of the engineering de-
2574 partment as well. I then resigned to accept a similar position at Union College, Schenectady, New York, and which position I still occupy.

During all the years intervening I have devoted a portion of my time to professional practice as a civil engineer, in late years specializing in the direction of sanitary and hydraulic engineering, more particularly in the lines of water supply, sewage and sewage disposal, stream protection and kindred topics. I have occupied various official positions besides, being engaged by municipalities in the capacity of civil engineer. I have been engaged in a number of instances in the capacity of consulting engineer. Among them, the City of Nashville, with the Board of Public Works, for which I was for two years consulting engineer in the investigation and study of the existing plant. Made recommendations as to its rehabilitation and the design and construction of a new system. I was also engaged by the same board to make investigations, surveys and recommendations regarding a new system of supply, which I did, and which works have since been built, having a capacity of 30,000,000 a day, at a cost of something over $1,000,000. In connection with the work dealing more especially with sewerage and sewage disposal, I was for 10 years the consulting engineer of the New York State Board of Health, and as such it was my duty to pass upon plans for many systems of sewers and sewage disposal before such systems were permitted to be constructed. Also it was my duty to examine into cases of extreme pollution and recommend remedies therefor, which frequently called for recommendations or the design of plans for treatment of sewage. I was engaged by the Tennessee State Board of Health to investigate and report on the probable sanitary effect of the proposed system of locks and dam on the Cumberland River as bearing on the san-tary character of the waters of the river which flowed *passed* the City. I was also engaged by the Tennessee State Board of Health to investigate and report on the subject of the smoke prevention, and my report was adopted and has been made the model for a number of
2575 recommendations. It has been made the model for a number of other towns and the report is largely quoted in Kent's Mechanical Engineers' Pocket Book. I was appointed special commissioner by the State Board of Health of Tennessee to examine and report on the sanitary engineering features of the World's Fair in 1893. I was a member of the advisory counsel of the Engineering Congress at the World's Fair in 1893.

In connection with my duties as consulting engineer for the New York State Board of Health, I prepared sets of rules and regulations for the protection of given water supplies against pullution. I was a member of the New York State Sewerage Commission from 1902-1903, to investigate and report on the matter of floods throughout New York State, and the feasibility of means for their prevention.

I was a member of the New York Bay Pollution Commission from 1903 to 1905.

I was a member of the Metropolitan Sewerage Commission of New York from June, 1906, to January, 1908.

In private practice I have prepared plans and specifications for disposal plants at a number of cities and towns in this state, and I am now preparing a report on the sewage disposal for the City of Oswego.

I have only mentioned those subjects which bear more or less directly on the matter of this case. I have been engaged in other lines of engineering, water power engineering and also, more recently, in engineering valuations, valuation work. I have been engaged as an expert in a great many cases of condemnation, among them, the taking of the waterworks of Ithaca, New York; the taking of streams by the City of Gloversville, New York, in which cases some six or eight different claims were being adjudicated. In similar capacity by the City of Johnstown, New York, where ten or twelve claims, at least, were adjudicated. In the City of Troy, New York, where the city took the stream and its source of supply, in which case there were at least a dozen cases for adjudication,
2576 and in which I was connected with all of them. Later the City of Troy also condemned another stream, Quackenkill, and there were some twenty or thirty claims for adjudication there, each one involving separate distinct water power, and with all of which I was connected as an expert in the valuation. I was also retained by the City of New York in the settlement of claims for water power property taken on the east branch of the Croton River, and was engaged and still am engaged in the adjudication of similar claims now before the court on the Catskill water supply.

Q. Professor Landreth, I think you testified previously that you were a member of the New York Bay Pollution Commission and that you were a member of the Metropolitan Sewerage Commission of this state from 1906 to 1908, and that personally you gave direct attention to the matter of harbor deposits, and their accumulation from sewage and other foul deposits on the floor of the harbor, did you not?

A. Yes.

Q. Now, as a member of the committee of the Metropolitan Sewerage Commission, I think you testified that you had charge of the methods which you devised for conducting an extensive line of investigations into the character of such deposits in various parts of our harbor. Do you recall so testifying?

A. Yes, I testified I was a member of the committee which had that in charge, and I did devise myself the boring apparatus for securing the samples.

Q. And the plans and drawings of that device are already in evidence?

A. Yes.

Q. Have you perused the evidence which places the details of those investigations on record in this case, and if so state by whom they were presented, if you remember?

A. I have perused those records. They were presented in the case, as I recall, by Mr. A. J. Provost, who was a member of the

same committee of the Metropolitan Sewerage Commission with myself. Some testimony also was given concerning those observations by David S. Merritt, who was our field engineer in charge of the parties by whom the observations were directly obtained. I
2577 think also some testimony was given bearing on the same series by Dr. Payn B. Parsons, who was a member of the field party during a portion of the time. I do not remember whether Mr. Miller testified on that matter or not. He certainly was connected with the party in the field.

Q. Did you yourself give any testimony that you recall previously on the subject of harbor deposits?

A. Yes. I gave testimony on the general tables of data that were submitted by Mr. Provost and I also prepared a series of summaries, tabulations, of the numerical and descriptive data in those tables in evidence.

Q. And did you, as you recall it, cover the description of the methods and the apparatus used, and also the tables that you have just described?

A. Yes, sir, and also attempted to arrange the data in form for easy examination by other witnesses so that they might find suitably and conveniently summarized the scattered observations as they were given in the original testimony. When I say scattered I mean just as they were reported in their chronological order without reference to the results which were to be drawn from them. In my summary I attempted to bring together data bearing on similar results. For example, I determined the relative degree of fouling of the mud deposits at different depths below the harbor bottom, showing the measure of pollution, the first foot, the second foot, the third foot, and so on.

Q. Have you read the testimony of these witnesses that you have enumerated?

A. Yes, sir.

Q. Have you examined yourself the data relative to harbor deposits and bacteria?

A. You have reference to the data that our commission obtained?

Q. And the data that has been acquired since then?

A. Yes.

—. Both?

A. Yes, I examined not only our own data but also the data which has been acquired by the Metropolitan Sewerage Commission of New York subsequent to 1908.

Q. Contained in what exhibits?

A. In Exhibit, I think No. 98.

2578 Q. Have you examined the photographic reproductions of the stations where the samples were taken, as given in Exhibits 100, 101 and 102?

A. I have.

Q. Have you studied the tabular results and observations made by the Metropolitan Sewerage Commission up to 1908, and which are shown in Exhibit Nos. 98?

A. Those in Exhibit 98 are subsequent to 1908.

Q. Have you studied those?

A. Yes, I studied those as well as those by our own commission prior to 1908.

Q. Now, Professor Landreth, will you state what results your studies yielded on these various exhibits, and on your own direct observations relative to the harbor deposits in New York Harbor?

Mr. Riker: The question is objected to on the ground that it calls for opinion evidence upon facts not entirely within the witness' knowledge, which facts are not stated in the question so that it can be determined whether or not they constitute facts proved in this cause.

The Commissioner: Note the objection of counsel for defendants.

A. They yield the result of indicating that the presence of deposits of foul character such as sewage and sludge are harmful in several ways. The first way by causing an obstruction to navigation, requiring expensive dredging to be accomplished, and causing the bottom of the harbor to assume a less solid form than would be the case from strictly mineral depositions. In the second place, they give rise at once to obnoxious odors which pass off from the water and become offensive to people who reside near there. In the third place, they cause a disagreeable appearance to the waters by reason of a large amount of finely divided suspended matters which rise from the sludge deposit and cause the water to be muddy and turbid, in some cases almost black. In the last case, that is the more serious of all, they lead to harmful results in that the waters lying over them are seriously impaired in their capacity to maintain self-purification and to carry on the natural reduction of organic matter discharged into the waters. The presence of a mass of putrid sludge or mud lying at the base of the harbor has a very
2579 strong and material effect on the waters lying over it in this relation of reducing the oxygen contents of the waters above them. In the second sense of increasing the amount of ammonia carried in the water, and in the third sense in decreasing the already accomplished nitrification of organic matters which has been carried on by chemical and biological processes in the water themselves, thus in fact virtually undoing some of the work which the waters themselves have accomplished towards the purification of the organic matter carried in those waters and necessitating naturally the doing of this same measure of purification over again a second time. The presence of sludge deposits also tends to encourage the growth of certain filths in the water, vegetation, some of which is very offensive. In a number of cases waters have produced forms of vegetation, when they reach a certain degree of pollution, which they did not possess before at all. In other words, the waters have come into the conditon where certain vegetable forms become favorably surrounded and they grow and develop to a great extent and become serious causes of discomfort, annoyance and danger to people living near those waters where the forms of vegetation have not heretofore existed at all.

My own observations led me to this, and my conclusions there are

fortified by the experience of other engineers largely in Europe, where the subject of sewage and its effects on streams has been studied more extensively and longer than it has in this country.

Q. How do these harbor deposits affect the oxygen content of the water above these harbor deposits?

A. They reduce the oxygen content.

Q. How?

A. They do so by exhausting the oxygen for purposes of combination with the gases given off by the putrefaction of the mud deposits themselves. In some instances it has been observed that where the waters of the stream or harbor are fairly well aerated and harmless in their measure of pollution, that they become suddenly deprived of their oxygen whenever, for one cause or another, the mud deposits are suddenly increased, as, for example, in certain rivers in England the presence of large deposits of muds and sludge from sewage in the upper reaches of the streams does not
2580 impair the waters of the lower portion of the rivers. But when on account of extreme range of tide or on account of Spring freshets the currents are sufficiently strong to disturb the deposit in the upper reach of rivers those deposits are brought down to the lower portion of the river and the oxygen content of the river immediately drops down seriously. The same is true as to the turbidity. The turbidity is very seriously and suddenly increased by reason of the comminuted particles of semi-putrid material which has been disturbed by the currents, and also the bacteria in their aeration by reason of globules of gas which attach themselves to the particles. I have frequently seen in New York Harbor, at different parts of the harbor, not only in the Gowanus Canal and Newtown Creek, but also in a dozen or more of the slips of the East River, and in several cases on the North River, I have seen particles of black sludge come to the surface, appear suddenly and then gradually break up into small particles. In every instance the rising of the lump of mud or sludge has been due to the production of gas caused by the decomposition of the organic matter mixed with the sludge, until the buoyancy of that gas has turned it loose from the bottom and brought it to the top. After bringing it to the top it is broken up into smaller particles and in some measure the larger particles are permitted to disappear and the smaller particles take its place, and in some instances the mineral materials themselves again settle. They settle as soon as the gas which bore them up has been separated and dispersed in the atmosphere. In other words, that particle is a model or exact copy of what takes place in an ordinary septic tank where a particle of organic matter entering with the sewage settles at first to the bottom, putrefaction sets up, gas is produced, the gas forms a buoy which brings the particle to the surface. The gas bubble then bursts and escapes into the air. The particle then, no longer having a buoyancy, necessarily seeks the bottom, and the same operation is continued until all the organic matter which has the capacity of producing gas has been decomposed. In the impairment of the oxygen of the water, how-
2581 ever it is the oxidation of the organic matter which consumes the oxygen of the air, especially the sulphides that are formed

in sea water by reason of the formation of sulphides in the decomposition of organic matter in the presence of sea water.

Q. Professor Landreth, is there any difference in the method of oxidizing these foul deposits that you have described and the process of oxidation as it takes place in fresh sewage?

A. Yes, a very marked difference.

Q. Will you describe that difference?

A. In the case of fresh sewage discharged into streams containing large amounts of oxygen the oxidation is accomplished very slowly.

Q. And by what process?

A. Largely by aid of bacteriological processes, and the rate of accomplishment of oxidation is limited by the rate of activity of the bacterial forms which accomplish this. In the case, however, of the exposure of putrid sewage, sewage of old age, that upon which putrefaction has already progressed, the oxidation is largely a chemical one and takes place very quickly. In some cases almost as rapidly as it would take place in the mixture of reagents in the laboratory. The production of the gases in the sludges which lie in the bottom are dependent very largely on the temperature, and it follows therefore that during periods of time when the temperature is unfavorable to the rapid putrefaction, then the solids simply accumulate. Organic matter simply accumulates. When, however, the temperature of the water rises to such a point as to encourage more rapid decomposition, then the decomposition progresses at a more rapid rate and it operates on all the accumulated sludge, that which comes down during warm weather as well as that which has already come down during the preceding period of low temperature. Thus, the evils which arise from sewage muds are not uniform the year round, but they tend to accumulate during periods of cold weather and become aggravated during periods of warm weather, when the burden is undertaken of decomposing not only those which have
2582 come down at that time of the year, but also those which came down during the preceding cooler period. That bears directly on the question of the irregularity of the effects and also accounts for a good many of the apparently discordant observations which have been made on the foulness of rivers and harbors, in which certain observers have found the streams to be free from gases and not objectionable, and at other times they are seriously objectionable. Those discordant reports can frequently be accounted for by taking into consideration the difference in season, and the difference in temperature, which, in some cases, those very discordant observations record.

Q. You have described the bacterial activities that result in oxidizing suspended sewage. Does it in any way vary as to the type of bacteria that operate and have a functional activity in the harbor deposits?

A. Yes. Bacteriologists have been in the habit of classifying these roughly into two classes. Those which operate on the suspended sewage, that is sewage suspended in the water containing oxygen are generally classed as belonging to the aerobic type. Those which require for their best activity oxygen as part of their func-

tional requirements. On the other hand, those which are able to operate most vigorously without the presence of oxygen have been called the anærobic. They are the ones which operate in the presence of the sludges and deposits where there is no possibility of oxygen being obtained. I do not wish to be understood as saying that all bacteria can be classified under these two classes, which have been called by the names ærobic and anærobic. Some bacteria, in fact many varieties may operate either in the presence of one or the other, but their highest virility is not accomplished except under one of those two conditions. I should say, with the exception of some varieties which appear to operate well with a partial or restricted amount of oxygen. But the two main typical results covered by your question are brought about by the two extremes, those that require for their best activity the presence of free oxygen in
2583 dissolved form and those which operate to their best activity in the absence of oxygen. The former are the ones that attack sewage in suspended form in the waters, if the water is well ærated. The second class are those which operate mainly on the organic matter of sludges in the bottom of streams or harbors, but it should be understood that the production of gases which takes place, and the reduction of the oxygen content of the water by reason of the gases is largely a chemical result. The putrefaction has been accomplished by a bacterial agency, but the robbing of the water of the oxygen is a chemical result brought about by the escape of gas through the water.

Q. Do these gases combine with the oxygen chemically?

A. Yes, sir. In the case of a number of streams that I have had occasion to observe and some others that I have studied, the reduction of oxygen has been very marked. I refer more especially now to the drainage canal of Chicago, where a large amount of sewage sludge is thrown down, and where the oxygen content of the lake water going in is very suddenly and rapidly deprived of its oxygen as it flows over the deposits of sewage sludge. In the case, also, of some of the water analyses conducted in New York Harbor by the Metropolitan Sewerage Commission, it was found that the oxygen content on flood tide, taken from some of the pier slips, was shown at a given figure immediately on the incoming tide, and that when observed several hours later, before the tide had materially gone out, the oxygen content in that same case had very materially reduced. That was made the subject of an extensive series of experiments. Dr. Adeney and his colleague, Professor Letts, in England, where they ascertained that in cases of laboratory experiments conducted on a large scale the presence of mud at the bottom of the receptacles tended not only to reduce the oxygen content of the water above them, but also tended to decrease the nitrates which were already in the water, and in some cases they had been added there by artifi-
2584 cial measure to a known amount. In other cases naturally there by selecting sewage polluted waters. The nitrates have been reduced and the ammonia has been increased, which agrees exactly with the observations in a number of cases, some of which I have already cited.

Q. Do you regard oxygen as the measure of the digestive capacity of waters.

A. It is one of the essential indices of the digestive capacity of waters. Other things being equal it may be accepted as a measure.

Q. Will visible suspended particles or harbor deposited sludge draw more heavily upon the oxygen content of the waters?

A. You mean to draw a comparison between the exhaustion of oxygen by deposits in one case and by suspended particles in the other?

Q. Yes.

A. Given the same quantity of organic matter and in the same state of decomposition there will be the same reduction of oxygen, but in the case of the finely divided particles it will be accomplished in a much shorter time. So that the rate of reduction of oxygen is more rapid where the particles are broken up and suspended in the water than where they are lying quiet on the bottom. Just as two chemicals, one lying in the bottom of a beaker or a glass, the other in solution in the water above would not mix so thoroughly as if the lower chemicals were stirred up and agitated with the water.

Q. Professor Landreth, have you tabulated the results of the observations which were made by the Metropolitan Sewerage Commission subsequent to 1908, and which are shown in Complainants' Exhibit No. 98?

A. I have, but I have not finished the copying of them onto final forms, so that I cannot hand them to you at this session. I shall have it ready though by the morning session.

Q. Is there anything about the physical conformation of this harbor that favors the accumulation of deposits on the harbor bottom?

A. Yes, sir.

Q. Will you state what they are?

A. The fact that the harbor is characteristically a closed harbor in distinction from an open harbor in a way renders it essen-
2585 tial that the only avenues of escape for the waters is the tidal cycle, and through the outlets which in this case are represented by the Narrows and by the East River and North River. Inside of the harbor, inside the bounds of these three outlets, there is a large amount, a large area of water in which precipitation may take place. It is landlocked. It is bounded on all sides, except at three points, by land. It cannot escape. It is a deep set canal in the larger area, the sedimentation area, within the bounds of that. Moreover, the configuration of the sea-ways outside of those narrow inlets is such as to favor the return on flood tide of a portion at least of the water which actually went out on the preceding ebb tide, and thus produces a less thorough dilution than would be the case if the incoming waters did not contain a part of the organic matters which they carried out on the previous tide. There is another physical and physiographic feature which also impairs the capacity of the harbor to secure high dilution. That is the fact that the phases of tide which come in from the East River are not simultaneous with those which come in from the narrows. The result is that instead of the water being piled up at the same instant from both sources,

and on the return being given out at the same time, the one preceding the other gives an opportunity for the tide to swing up on one and then back into the other, so that we get less effect in any one instance, less actually passing outside the boundaries of the harbor than we should if the tides flowed exactly simultaneously.

Q. Do these physical and physiographic peculiarities of New York Harbor favor the transportation or deposition of suspended sewage?

A. It tends to favor it so far as relates to the topographical feature of there being a large harbor content, and therefore slow velocity of movement inside. If, in other words, the harbor were narrowed down to channels instead of being a broad base with the same area of tidal inflow at the Narrows and the East River, we should get a better dilution, much less precipitation of solids than we get
2586 at present. Therefore, it may be said that the physical configuration of the harbor contour inside the tidal inlets tends to a precipitation of solids and the production of deposits.

Q. Does the salt water itself aid in that precipitation to any extent?

A. Yes.

Q. Do the sulphates in the sea water influence the deposition or deprivation of the waters of oxygen?

A. Influence the exhaustion of the oxygen contents.

Q. Have you had occasion to study any other harbor conditions that somewhat resemble ours as far as the deposits are concerned?

A. Yes, I have examined most of the harbors in this country personally, and I have made careful studies of the results of observations and measurements made in many other harbors which I have not personally examined myself. I have examined the Boston Harbor on three or four occasions, scattered over five or six years past. I have examined on three or four occasions the harbors at Norfolk, also at Charleston, Washington, Baltimore, Seattle, San Francisco, San Pedro, New Orleans, Mobile.

Q. In your testimony a little earlier you mentioned Belfast. Are there any conditions that are anywhere analogous with the conditions in this harbor?

A. Yes. The river that runs through Belfast empties into a long V-shaped narrow bay called Belfast Lough. Until a period some years ago the sewage was discharged at various outlets directly into the river. Owing to the nuisances and objectionable conditions brought about by that discharge, improvements were made in the sewage system, intercepting sewers built and the sewage discharged, not only at the lower end of the city, but by a long submerged conduit out into the broader portion of the lough. One of the results of the sewage contamination of the lough and river had been the growth of a form of seaweed, sea lettuce, so called.

Q. Is that the Ulva latissima?

A. Yes, and that was one of the factors in which an improvement had been sought in the sewerage system. It was believed that the odors, which were discovered to come from the sea-weed itself,
2587 came from the sewage. So, under a mistaken idea there was a strong feeling in favor of abating the flow of sewage direct,

taking it farther out into the lough. So, when the sewage system was improved, and the sewage discharged farther out into the lough, while the upper river was materially benefited and improved, the condition as to the growth of the Ulva Latissima was rendered worse. It was pushed farther out into the lough, transported down stream, and to so great an extent that regions of the lower lough which ordinarily had been clear of the lettuce, after the sewer system was built they became badly fouled by it. A study was made of the subject by a number of experts, particularly Doctors Adeney and Letts, and they showed that the seaweed was dependent entirly on the sewage conditions in the water. It depended on it for its food, and existed where the highly polluted sewage water occurred, and it did not exist where it was absent. So that the conditions in this respect were that the moving down stream of the point of discharge tended to improve the upper river and to foul the lower river. Those conditions are strikingly similar to the question that is concerned here. If our upper streams are at present badly polluted, and if we are to abate that pollution by bringing the organic matter down, we simply transfer the point of annoyance and discomfort to a point lower down stream. A similar experience occurs in the case of the River Ouse in England, where the river in its lower portions is not highly objectionable at most times of the year, although the upper tributaries are badly polluted, and I think I have referred to that in a different connection in my testimony today. If those upper tributaries, three or four in number, are adequate to receive and precipitate the sewage sludge and to retain them in the upper reaches and not to foul the lower river, but when the conditions of the stream are such as to tend to disturb those accumulations of sludge, and they are brought down then the trouble is transferred to the lower water, and

2588 I think that may be accepted as a rule in general that a point of pollution, the point of outfall of a sewer, will be the nucleus or center of the harmful influences that come around it. As you go down stream farther and farther they are less and less. If, therefore, you move the outlet farther down, you move the conditions farther down. If you move the outlet farther up you move the conditions farther up, although precipitation does not occur right at the outlet at the first opportunity which is offered in the slack waters in the vicinity of the outlet, and is transported by the stream flow and the tidal motion a moderate distance up and back.

Q. In what way do the conditions at Belfast Lough seem analogous to the conditions in New York Harbor, such as they would likely be if the Passaic Valley Trunk Sewer project should be perfected and put in operation?

A. The analogy between the two cases is this: The river at and above Belfast may be likened to the Passaic River at and above Newark. If we gather the sewage of that river and bring it down to a point in the lower portion of the Upper Bay we are producing an action such as that in Belfast by collecting the sewage in intercepting sewers and bringing it down and then bringing it out by a tunnel into the lower harbor. The analogy is also similar in the fact that we have a fresh water stream in one case flowing into a tidal and

narrowed harbor in the other case. In fact, all of the controlling conditions are similar, and we may conclude from that, entirely apart from any other basis of reasoning, that if we do here what has been done in Belfast we shall accomplish substantially the same results.

Q. Which are what?

A. That we shall improve the conditions of the upper river, in this case the Passaic River, to the detriment, to the serious detriment I believe, of the conditions of the Lower Bay, in Belfast, the Belfast Lough, and in this case the Upper New York Bay, the lower portion of Upper New York Bay.

Q. Have you prepared a diagram or map of Belfast Lough showing the sewer with its changed point of discharge?

A. Yes. I have had a tracing made from a British Government map, from a British report on the subject, showing the con-
2589 figuration of the bay and lough and the point of outfall of the sewer tunnel.

Q. Have you got it with you?

(Witness produces map.)

A. I have.

Q. What does that map show that you have produced?

A. The map shows the Belfast Lough, a long slender bay, shown by the heavy short line, Belfast at the apex, and the entrance of the V, situated about ten or twelve miles to the sea, about fifteen miles to sea.

Q. Have you compared this with the original?

A. Yes, sir.

Q. How does it compare?

A. It is an exact copy of the original, except that the original has some configuration of topography, mountain ranges, which I have omitted from this map.

Mr. O'Sullivan: I offer this map in evidence and asked that it be marked Complainants' Exhibit No. 142 in evidence.

Cross-examination by Mr. Riker:

Q. This is a copy of the map produced by the British Government report?

A. Yes.

Q. Is anything added to it?

A. Nothing is added. A few characteristics relating to the inland topography have been omitted.

Q. Nothing added?

A. Nothing has been omitted which relates to hydrography. I should say in further answer to your question that this map shows between the heavy shore line by a lighter dotted line the tidal bank or grounds which are uncovered at low tide. In this map there is indicated also the presence of the growth of the Ulva latissima heretofore mentioned with the little triangular dots. And this growth is more luxuriant on the south and easterly side of the lough than on

the north and westerly side. The present map shows the conditions as they occurred after the examination of the sewage outlet which I have referred to. Before the construction of the outlet, and before
2590 the construction of the intercepting sewers, which brought the sewage down to the lower bay, the growth was confined more nearly to the apex of the harbor. More nearly to the vicinity of Belfast.

Q. I was not asking that, Professor. I was asking you a different question.

A. I beg your pardon.

Q. In the original map were there any depths of water indicated?

A. They are indicated by the location of the 5,000 feet line and so forth.

Q. No more than is now indicated on this map?

A. No more than is now indicated on this map.

Q. When was the original map made, do you know?

A. Made about the year 1908. The map was made then. It represents conditions that had occurred some time before that.

Q. When was the extension of the sewer made?

A. I cannot tell you just about the year. It was in the early 1900's or the late 90's.

Q. Where is the sewer indicated on the map?

A. The outfall sewer at the point of the outlet is indicated about two miles northeast of the City of Belfast, and is marked on the map.

Q. That is the point of the outlet?

A. That is the outlet which was there at this time. Since that time, in order to abate the conditions which were found to be caused, they pushed it further down stream. The city has gone into the work of sewage purification in part, so that the conditions as shown at the time this map was made do not exist at present owing to the fact that the city has installed, in part at least, treatment for its sewage, and not simply a harbor discharge, and that was due to the discovery that their expected remedy did not remedy. It simply transferred the trouble farther down stream.

Q. And, of course, that present condition is not represented on this map?

A. That is not represented on this map, no. If it were, the amount of evidence indicating the presence of lettuce would be decidedly diminished. It is so described, though I cannot say to what extent. The supposition is that not until the sewage already has accumulated and had its organic matter decomposed will the full elimination of the trouble occur, which may take some time.

2591 Mr. Riker: I will have to ask that that testimony be stricken out as not responsive to the question.

The Commissioner: Note the motion of counsel for defendants, to strike out.

Mr. Riker: The offer is objected to on the ground that the paper is not an original, nor is it properly proved and is immaterial and irrelevant.

The Commissioner: Note the objection of counsel for defendants.

Received and marked Complainants' Exhibit No. 142.

Direct examination by Mr. O'Sullivan (resumed):

Q. What is the source of food for this Ulva latissima that is indicated on this map, Complainants' Exhibit No. 142?

Mr. Riker: The question is objected to on the ground that it does not appear as yet that there is any variety of this present in New York Harbor. Therefore, the question is immaterial and irrelevant.

The Commissioner: Note the objection of counsel for defendants.

A. The source of food is contained in the nitrates, ammonia and nitrogen, which come from the decomposition of the sewage in the water.

Q. Are these saprophytic plants?

A. No, I should say not, but they feed, as other plants do, on comparatively simple forms of chemical compounds, and nitrates and nitrites and carbon dioxide. In that sense it may be said that all vegetation is saprophytic that receives artificial fertilization by manurial sources.

Q. Are the sewage solids in New York Harbor a detriment or a benefit?

A. I should say decidedly a detriment.

Q. How would you expect, if the Passaic Valley Trunk Sewer project was in operation, to get similar results to what you have depicted as following from a like change in Belfast Lough?

A. I should expect that we would have similar conditions to those that now exist in the Upper End of Newark Bay and in the Passaic River, to be reproduced, not in the same intensity perhaps, in
2592 the waters of New York Bay. In one sense there would be a tendency to aggravate the conditions which now exist in Newark Bay and the Passaic River. In the other sense there would be a tendency to dissipate and render them less serious. The bringing down of the sewage from the Passaic would cause it to be discharged into a much larger volume of water than occurs now, and in so far as the effect of that goes it would be remedial and produce results which are not as serious as occur now in the Passaic River and the upper end of Newark Bay. On the contrary we should have that same amount of sewage discharged within a very small area, only being transported off twelve or fifteen miles from the river and discharged at many outfalls, so that in one sense we should have greater dilution. In the other sense we would have greater concentration. I do not wish to be understood as predicting that necessarily the Ulva latissima will grow in New York Harbor, but the conditions which produce it would be produced here and we might even have the Ulva latissima itself. It is a plant which inhabits waters somewhat similar to ours. The climate is not different enough to preclude its growth here if it were ever planted here, and it is liable to be planted here whenever the waters become sufficiently densely polluted to favor its growth. Any ship coming over may bring it, may plant the seed here, and we cannot predict from the fact that we have not had it that we never should have it. In a way the producing conditions are favorable to it. But, even assuming that we never suffer from the

Ulva latissima itself, that is a matter of secondary importance. The sewage pollution on which the Ulva latissima is dependent would be produced here and would be aggravated here by bringing the outlet of the New Jersey sewage farther downstream. We should transfer from the upper rivers to the lower end of New York Bay the conditions which now occur in Newark Bay and the Passaic River to a less extent.

Q. Have you seen the contour map that is placed in evidence in this case or the contour map of the harbor bottom?

A. Yes.

2593 Q. Being Complainants' Exhibit No. 126?

A. Yes.

Q. Are there pockets in the harbor bottom that favor the retention of the sewage deposits?

A. Yes, sir.

Mr. Riker: The question is objected to on the ground that the contour map, if properly in evidence, speaks for itself.

The Commissioner: Note the objection of counsel for defendants.

Q. Yes, there are such pockets, but even if there were no pockets, even if the contours were not entirely regular and did not enclose any low deep spot, the fact that there is a large volume of tidal prism of water lying below the low tide tending to produce slow motion of the tidal currents will, in itself, tend to precipitate sewage even if there were no pockets. The occurrence of pockets however tends to aggravate it and tends to prevent the escape of those portions of the deposits which are not quite precipitated on the bottom, but which are being precipitated, or being very easily disturbed by the swing of the tide, or by the rapid currents, because those matters which lie between suspension and sedimentation are easily rolled along the bottom in a horizontal motion, or in a downward motion, but they cannot climb uphill, and any barrier thrown across their path tends to obstruct their motion. Now, the occurrence of a pocket produces such a barrier as that. Whatever of this semi-suspended or semi-precipitated material is deposited inside that pocket finds it impossible to climb out, while it may do so slowly by the alternate swing of the tide, if it were not for the pocket.

I have already testified in this case on the occurrence of such a bar or barrier, caused by the harbor bar at the lower end of the Lower Bay through which Ambrose Channel has been diminished and finding there a depth of sewage sludge which had accumulated on the upstream side of the bar to a depth at one point of twelve feet or more, while the outside or ocean face of the bar was clear.

Q. In your study of Complainants' Exhibit No. 126, did you find any such pocket as you have described would have these
2594 effects in the neighborhood of the upper part of New York Bay which has been selected for the outfall of the Passaic Valley Trunk Sewer?

A. Yes, sir. There is a long elongated pocket there into the side of which the proposed Passaic Valley Sewer is proposed to discharge

at a point above the bottom. There are other pockets farther upstream, and what may be called another pocket down at the Narrows.

Adjourned to June 27, 1912, at 10.30 A. M.

Supreme Court of the United States, October Term, 1911.

THE PEOPLE OF THE STATE OF NEW YORK, Complainants,
against
STATE OF NEW JERSEY and PASSAIC VALLEY SEWERAGE COMMISSIONERS, Defendants.

Before: James D. Maher, Esq., Commissioner.

CORPORATION COUNSEL'S OFFICE,
NEW YORK, June 27, 1912—10.30 a. m.

Appearances:

Dr. William J. O'Sullivan, Special Counsel for the People of the State of New York, Complainants;
Adrian Riker, Esq., of Counsel for Passaic Valley Sewerage Commissioners, Defendants.

2595 Met pursuant to adjournment.

GEORGE A. SOPER, a witness called on behalf of Complainants, recalled for further examination, testified as follows:

Direct examination by Mr. O'Sullivan:

Q. Are you now president of the Metropolitan Sewerage Commission of New York?
A. I am.
Q. How long?
A. Since 1908, May or June I think was the month. It might have been earlier in the year. It was not later.
Q. And previous to that were you a member of the Metropolitan Sewerage Commission before the reorganization?
A. I was.
Q. For how long?
A. Since the day on which all the original members were appointed, January, 1906.
Q. And prior to that, Dr. Soper, were you a member of the New York Bay Pollution Commission?
A. I was.
Q. For how long?
A. Throughout its existence.
Q. And when was it called into being?
A. It was appointed in 1903, and I think it went out of existence in 1906, just before the Metropolitan Sewerage Commission was appointed.
Q. Since 1903 have you been continuously conducting scientific

investigations to determine the digestive capacity and allied matters relative to our harbor waters?

A. I should not say continuously, if by that is meant daily occupation, but since 1903 I have been connected with the subject.

Q. When you testified previously in this suit, Dr. Soper, you stated the degrees you held?

A. I do not remember.

Q. Will you state them again, state your training and experience in your profession?

A. That is my training in connection with subjects which relate to this investigation of the Metropolitan Sewerage Commission, I suppose I am desired to state. I have the degree of Bachelor of Science from Rensselaer Polytechnic Institute at Troy; the
2596 degree of Bachelor of Arts and the degree of Doctor of Philosophy from Columbia University; the degrees of Master of Arts and Doctor of Philosophy were given as the result of work in science at Columbia which I pursued as a post-graduate student.

Q. Are you a member of any profession?

A. I am an engineer.

Q. Do you belong to any engineering associations or societies?

A. I am a member of about a dozen scientific or technical associations.

Q. Will you name some of them, Doctor?

A. I am a member of the American Society of Civil Engineers; member of the Boston Society of Civil Engineers, member of the American Waterworks Association; member of the American Public Health Association; Fellow of the American Association for the Advancement of Science; member of the Royal Sanitary Institute of Great Britain; member of the Society of American Bacteriologists; member of the American Chemical Association, and I do not remember the rest of them. There may be others.

Q. Doctor Soper, will you say how the Metropolitan Sewerage Commission is composed as to its membership?

Mr. Riker: The question is objected to as immaterial and irrelevant.

The Commissioner: Note the objection of counsel for defendants.

A. It is composed of five members, four of whom are engineers, one of whom is a physician.

Q. Will you give their names, Doctor?

A. The engineers are Charles Sooysmith, H. de Berkeley Parsons, James Fuertes, George A. Soper and the physician is Linsly R. Williams.

Q. And you are the president of that commission?

A. I am the president, yes.

Q. How is the work apportioned to the different members?

Mr. Riker: The same objection.

The Commissioner: Note the objection of counsel for defendants.

2597 A. The work is not apportioned unless an unusual definition is given to that term. All of the work of the board, espe-

cially that relating to the collection of data, is done by one of the members, with the assistance of a staff of employes.

Q. In what does the staff of employes consist. Give the names and special function of each of the assistants?

Mr. Riker: The same objection.

The Commissioner: Note the objection of counsel for defendants.

A. The staff varies from time to time both in size and in functions, depending upon the particular problems to be done in large part. The policy of the commission has been to employ the most competent assistants procurable, each man being in considerable degree a master of the subject he is expected to deal with, and that plan has been proposed instead of the more usual one of employing a large number of men, few or none of whom have had much experience in their line of work. At the present time the force of the commission is small, there being but six assistants. Do you wish their names and their functions?

Q. If you will, Doctor?

A. One of the assistants is Kenneth Allen, senior in point of connection with the commission. He is one of the engineers which the commission has employed. The commission has had no chief engineer at any time, unless the executive member of the board is entitled to that designation. Mr. Allen's duties have been as an assistant in the more strictly engineering phases of the commission's work, tidal studies, various experiments in the field, the making of estimates and plans, numerous reports on designated subjects. Mr. Charles A. Holden is an assistant engineer. He has been largely engaged in the study of engineering projects for the treatment of the sewage of New York after its collection to central points, on problems of collecting the sewage to the central points for final disposition. Other work which Mr. Holden has had to do has been in the collecting of analytical data, its interpretation. The making of diagrams and
2598 similar workd. Max L. Berry is a draftsman who has done most of the drafting work of the commission. It consists largely of maps and plans and diagrams. Mr. Berry has also studied upon standard government charts the location of points from which samples of water or solid matters from the harbor bottom have been collected for analysis. Another member of the staff is William R. Cokeland, chemist. Mr. Cokeland has been engaged upon laboratory work, partly of an experimental nature, seeking to find and perfect methods of analysis, and Mr. Cokeland has made numerous analyses of the water and has conducted various experiments on the purification of sewage in order to make fit the sewage to be discharged into the harbor without danger or offense.

Payn B. Parsons is a member of the commission's staff who holds the title of sanitary inspector and bacteriorologist. Doctor Parsons has been engaged in making numerical determinations of the bacteria in the water; in making analyses of the water for dissolved oxygen; in carrying on numerous laboratory and field experiments relating to the oxygen problem.

And Anna C. Coonan is the final member of the commission's staff

at present, occupying the position of stenographer, with a knowledge of sanitary science; Miss Coonan has had immediate charge of all the typewriting done for the commission, and for this case in so far as requests have been made by the Law Department of the City of New York to the Metropolitan Sewerage Commission for transcripts of data. Miss Coonan attends to the details of bookkeeping, and in other ways is of assistance in the office. All the assistants report directly to the executive member of the commission, and the work projected is brought by that member to the attention of his fellow members of the board at various meetings. At various periods in the commission's history committees have been formed of members of the commission to attend to certain specified work which
2599 the commission has thought it desirable that the commissoners themselves should attend to outside of the meetings. Those committees have made reports to the commission as a whole and the commission has decided what should be done with the reports.

Q. Who is the executive member, Doctor Soper, of the commission?

Mr. Riker: Same objection.

The Commissioner: Note the objection of counsel for defendants.

A. The president of the commission is the executive member.

Q. Now, Doctor, will you describe in general the various investigations made to date, giving the facts attending the discharge of sewage, the extent to which such discharge was injurious to public health and ways to improve the conditions of disposal of sewage to meet the requirements of the present and the future.

Mr. Riker: The same objection.

The Commissioner: Note the objection of counsel for defendants.

A. Mr. Riker: Also on the ground that the question is so broad as not to be limited to the issues in this cause.

The Commissioner: Note the objection of counsel for defendants.

Q. Proceed, Doctor.

A. From the form of the question and from my understanding of it I am asked—a great deal of detailed data have been put forward in this case and are accessible in the printed reports already in evidence or about to be put in evidence in this case. I suppose I am wanted to deal with the subject in its broader aspect. It would take, I estimate, some weeks for me to go into the details of the investigations that have been made by the commission, and then I believe that some of the smaller details might be omitted. The commission undertook in the beginning of its work to find out what had been done already in investigation of the subject assigned to the commission, that is, the pollution of the harbor, and what measures,
2600 if any, had been taken in order to protect the harbor against sewage in time to come. The first study then was made of reports printed and accessible otherwise, made by whosoever had studied the problem. The Metropolitan Sewerage Commission issued a pamphlet report termed a digest of data, in January, 1908, relating to the sanitary conditions of New York Harbor. That pamphlet

was printed in 1909. It is here if you wish it for evidence in this case. It comprises eighty-seven pages of octavo size.

Q. You may proceed, Doctor.

A. After finding what was known concerning the problem the commission proceeded to plan an investigation which would further the knowledge. The plan was approximately as follows, to make a study of the tidal phenomena of the harbor with special reference to determining the velocities of the currents and volumes of water flowing in each direction in the main tidal channels, and past the principal points in the harbor. The object of that work was chiefly two fold, to determine under what circumstances and to what extent it was mechanically transported to sea by the currents, and secondly to determine to what extent sewage was caused to oscillate back and forth in the vicinity of its points of origin. Another line of investigation was into the digestive capacity of the harbor. The digestive capacity was understood to be the power of the water with its contents of living animals and plants to assimilate sewage which was discharged into the water from whatever source. The commission undertook as part of its plan to determine the circumstances and extent to which sewage is being discharged into the harbor from New York City and other municipalities in the Metropolitan District. The commission sought to determine the ways and extent to which the public health was or was liable to be injuriously affected by the discharge of sewage into the harbor, and as a result of the investigations made by the commission a report was drafted and published, containing many of the results of the commission's work of investigation, and certain opinions and recommendations to which that work of investigation had led. The report was published in 1910. I have a copy of the report here.

2601 Q. That was the report of April 30?

A. This is the report of April 30, 1910. It consists of about 550 pages, quarto size text, tables, diagrams, maps and half-tone photographs. I do not know whether you wish me to put that report in evidence or to describe it in its general form.

(Witness produces report.)

Q. Describe in general terms the report that you have just produced?

Mr. Riker: Is his description for identification?

Mr. O'Sullivan: Yes.

Mr. Riker: Not for the purpose of stating the contents?

Mr. O'Sullivan: No.

A. In repetition of what I have just said, the report is a printed volume of 550 pages of quarto size, bound in blue cloth. It contains maps, half-tone photographs, tables and other material. It is dated April 30, 1910, and is addressed to the Honorable William J. Gaynor, Mayor of the City of New York, and signed in the letter of transmittal by the Metropolitan Sewerage Commission of New York, and each of the members of the commission.

Q. Referring to this copy of the report of the Metropolitan Sewer-

age Commission, dated April 30, 1910, which you have just produced, did you at any time take that to the Mayor's office to have it compared with the original report furnished on that date?

A. This report has been taken to the Mayor's office and compared with the original on file there, and is certified to by James Mathews, Executive Secretary, Office of the Mayor, as being a correct copy.

Q. Doctor Soper, has that copy that you now produce ever left your custody since it was certified?

A. Yes.

Q. Describe under what conditions?

A. The copy was taken to the Mayor's office by one of my assistants and he has had charge of it ever since. He got the certification and he has had it here, brought it to this hearing on a previous occasion when I was expected to testify but was prevented from doing so by illness. He has brought it here this morning.

Q. Then it has been in the custody of either you yourself,
2602 the commission, or the employes of the Metropolitan Sewerage Commission since its certification?

A. Yes.

(It appearing that certification was not in satisfactory form, the report above mentioned was again sent to the Mayor"s Office for certification.)

Q. Dr. Soper, will you state in general terms the analytical work that was gone through by the Metropolitan Sewerage Commission, giving the number of analyses and matters, a general description?

Mr. Riker: The question is objected to on the ground that it is irrelevant and immaterial, to the issues in this cause, the issue in this cause not being the work done by the Metropolitan Sewerage Commissioners, but the probability of a nuisance being created in the Bay of New York through the operation of the proposed Passaic Valley Trunk Sewer.

Mr. O'Sullivan: The question is pressed by complainants' counsel for the reason that this analytical work both in its detail and the interpretation thereof will show conclusions that the digestive capacity of New York Upper Bay has been exceeded, and it is not capable of sustaining the extraordinary burden about to be imposed upon it by the Passaic Valley Trunk Sewer project.

The Commissioner: Note the objection of counsel for defendants.

Mr. Riker: In reply to the remarks of counsel for complainants I wish it to go on the record that counsel for the defendants is pleased with the admission by complainants' counsel that the City of New York is already polluting the harbor to such an extent that it has become a nuisance.

Mr. O'Sullivan: In reply to the statement by defendants' counsel, counsel for complainants desires to state that the extreme pollution entering the Upper Bay is very largely from the septic sewage as described by Mr. Fuertes, who was on the stand yesterday, and
2603 that drains directly, a large volume of this septic sewage comes from riparian communities on the New Jersey shore and not from the City of New York.

A. The total number of analyses of all kinds made by the Metropolitan Sewerage Commission up to January, 1912, was 8,786. Of this number there were 1,100 microscopical examinations of deposits from the harbor bottom, and 1,105 bacterial examinations of the deposits. 566 chemical examinations of the deposits. 1917 bacterial examinations of the waters, and 918 chemical examinations of the water, and 3,180 dissolved oxygen analyses. These relate to the waters and deposits at the bottom of the waters of New York Harbor and include about 500 analyses made in Long Island Sound and Boston Harbor.

Q. Now, Doctor, in addition to the analyses of water and of harbor deposits, these analyses being as you described both chemical and bacteriological, did the commission also conduct microscopical examinations of samples of both water and harbor deposits?

Mr. Riker: The question is objected to on the same ground and on the further ground that the Metropolitan Sewerage Commission is not now on trial in this case, is not a party to this suit.

The Commissioner: Note the objection of counsel for defendants.

A. No microscopical examinations of water, but of solid matters from the bottom of the harbor.

Q. Now, Doctor, what inferences were drawn by the Metropolitan Sewerage Commission from these analyses referring to the different portions of the harbor, both as to its water content and the deposits on the bottom?

Mr. Riker: The question is objected to on the ground that the answer is necessarily immaterial and irrelevant, and on the further ground that it does not appear on what basic facts in evidence in this cause such conclusions may have been reached. Further because the conclusions of a commission of the character described are not the subject of cross-examination in this cause, and therefore are not evidence in this cause.

The Commissioner: Note the objection of counsel for defendants.

2604 Mr. Riker: A further objection that proper proof of the conclusions of a body of the character described should be shown by its minutes and not by a member of the commission.

The Commissioner: Note the objection of counsel for defendants.

A. The commission formed the opinion that the waters of the harbor were everywhere and at all times polluted by sewage, and to an extent which was easily measurable by analytical means, and to an extent which made it necessary for the public health and welfare to at once take steps to restrict and prevent the further pollution of those waters.

Q. Has the commission taken into consideration what in all probability will be the character of the Passaic Valley sewage at the time it reaches the outfall at Robbins Reef?

Mr. Riker: The question is objected to on the same grounds as the last question was objected to.

The Commissioner: Note the objection of counsel for defendants.

A. It has.

Q. And with what results?

Mr. Riker: Same objection.

The Commissioner: Note the objection of counsel for defendants.

A. The commission believes the sewage from the Passaic Valley Sewer would be particularly objectionable if discharged into the harbor.

Q. Doctor, will you describe in general terms the character of the water in the Upper Bay and its present degree of pollution, taking it at different seasons of the year?

A. The water in Upper New York Bay has been found to bear evidence of a badly polluted tidal estuary. According to the results of analyses the water contained less than three-quarters as much oxygen as should be present. The bacteria are large in numbers. Particles of sewage origin can be seen with the naked eye, and where currents permit, in the Upper Bay, deposits of material of sewage origin take place from the water. Such other analyses as have been made of the water substantiate and confirm the
2005 results of determinations of dissolved oxygen.

Q. Do you regard the oxygen content of the water as a fair criterion to measure its digestive capacity by?

A. It is one of a number of criteria. It is probably the best single gauge of the intensity of sewage pollution.

Q. Can you give approximate estimates, Doctor, of the quantities of gaseous liquid and solid organic matters that are now being discharged daily into New York Upper Bay waters?

A. The gaseous impurities have not been estimated, but the solid matter, organic matter, and the quantity of liquid matter entering the bay have been estimated for 1910. Every day a total of 88,200 pounds of solid organic matter is discharged into Upper New York Bay. The same quantity of liquid organic matter. It is the organic matter which is of chief interest, as the sewerage commission regards the subject. These estimates are based on population draining into the Upper Bay according to the census of 1910, assuming 800 parts per million of solids in the sewage with 100 gallons per capita of sewage. At that rate the volume of sewage would be about 52,000,000 gallons per day.

Q. And of that quantity, Doctor, has the commission been able to apportion approximately how much comes from New York State communities and how much from New Jersey communities?

A. I have figures which show that in the volume of sewage—the proportion between the volumes of sewage will indicate the proportion of the various constituents which I have mentioned. As matters stand, about 10 per cent. comes from New Jersey and 90 per cent. from New York. Those are approximate figures.

Q. Now, as to the physical properties of the waters of the Upper Bay, has the commission considered that phase of the question, with reference to its capacity for absorbing liquid and gaseous products from the decomposition of sewage?

A. Physical properties?
Q. Yes, of the water?

Mr. Riker: The same objection.
2606 The Commissioner: Note the objection of counsel for defendants.

Q. Physical or other properties of the water?
A. The commission has considered the chemical and biological properties of the water and of the physical properties which you may have in mind, temperature.
Q. Have they considered those physical, chemical and biological properties in relation to the capacity of these waters for absorbing gases and liquid products from the decomposition of sewage?
A. They have.

Mr. Riker: Same objection.
The Commissioner: Note the objection of counsel for defendants.

Q. And with what results, Doctor?

Mr. Riker: The same objection.
The Commissioner: Note the objection of counsel for defendants.

A. With the result that the commission has formed the opinion that the waters are already being severely taxed to absorb the sewage which is being discharged into the waters and that measures should be taken to restrict and prevent not only the further pollution of the waters by sewage, but the pollution which exists at the present time, as far as it is practicable to do so.
Q. Now, Doctor, in the oxygen determinations that were made under the direction of the commission, who did the actual analyses for the commission?
A. Payn B. Parsons did practically all of the field work.
Q. And did the commission secure the advice of any outside chemists to test the methods or standarize apparatus or prepare solutions or other matters for them, and if so, state who was employed?
A. The method employed was decided upon by the commission, one of whose members had seen it in use in Europe, and the commission had no laboratory in which it could make up standard solutions or test the method in various details, and it seemed desirable to employ a chemist who had a laboratory for that purpose. Professor Metzger, of Columbia University, who had assisted one of the commissioners in a somewhat similar way in other investigations,
and had proved competent, was engaged to make up the
2607 standard solutions and to calibrate apparatus to be employed,
and if possible to reduce the time required in the conduct of the test. It was believed that the test could be made by the use of permanganate of potash instead of bichromate of potash, which one of the persons in Europe, who was most familiar with the test, insisted upon as necessary for ocean and tidal harbor waters. If bichromate of potash was employed the method could not be used as a field method, but if permanganate of potash could be employed

it would be possible to use the test in boats during rough and stormy weather on the harbor, and Professor Metzger was requested to make various tests with permanganate and salt water to determine whether permanganate could not be used. The result being in the affirmative, Professor Metzger was employed to make up standard solutions, which the commission's lack of laboratory facilities prevented them making. After the work had progressed in the field for some time other modifications were made in the method by the commission, and outside chemists were employed to make a critical examination of the procedure exactly as it was followed by the commission's staff. Professor Gill of the Massachusetts Institute of Technology came to New York from Boston, examined the method as it was employed by Dr. Parsons on the harbor, and endorsed the method as being accurate.

Mr. Riker: I shall move to strike out the testimony in regard to endorsements by this party as being hearsay and not competent.

The Commissioner: Note the motion of counsel for defendants.

Q. Proceed, Doctor Soper.

A. Professor Gill, however, was urged to be as strictly critical as possible, and he raised the point that the method might under certain exceptional circumstances fail. To make certain whether the method would fail under those circumstances, Professor Gill was requested to make a research in his laboratory in Boston. He was requested to compare the commission's method with the method known among analysts as the Winkler Process, and what is customarily known as the ultimate criterion, the boiling out
2608 process. In the boiling out process the water is heated until the oxygen is entirely driven out with other gases, the gases analyzed, and the oxygen accurately determined. The result of Professor Gill's research was reported by him to the commission. The doubt which might have existed in the minds of some had been removed and the method had been shown to be accurate. Since then the method has been examined by many experts who have reported on their results. The opinion has been that not only is the method employed by the commission accurate, but the only accurate method known for the determination of dissolved oxygen in tidal waters.

Q. These reports were made to the commission, were they, Doctor?

Mr. Riker: The same objection.

The Commissioner: Note the objection of counsel for defendants.

A. The reports of Professor Metzger and Professor Gill were made to the commission.

Q. Now, who did the microscopic examinations of the harbor deposits for the commission?

Mr. Riker: The same objection.

The Commissioner: Note the objection of counsel for defendants.

A. The work was done by Doctor Pond and Mr. Robert M. Hoyt. I think Doctor Parsons made a few determinations.

Q. Where is Doctor Raymond Pond, alive or dead?
A. He is dead.
Q. And Mr. Robert M. Hoyt is the Health Officer of Princeton now?
A. I understand that he is.
Q. As to the bacteriological work accomplished, who made the bacteriological determinations for the commission?

Mr. Riker: The same objection.
The Commissioner: Note the objection of counsel — defendants.

A. Doctor Parsons of the commission's staff.
Q. Did the commission cause the large amount of accumulated data that you have described as going into some thousands of those analyses—did the commission cause them to be tabulated
2609 and also to have averages made thereon?

Mr. Riker: The same objection.
The Commissioner: Note the objection of counsel for defendants.

A. Yes.
Q. Both for oxygen determinations and for bacteriological determinations?

Mr. Riker: The same objection.
The Commissioner: Note the objection of counsel for defendants.

A. Yes.
Q. From the large amount of data accumulated by the Metropolitan Sewerage Commission, which you have briefly described, has the commission been able to determine the longest period of time that a floating particle of sewage discharged at Robbins Reef Light will remain intermediate in the Upper Bay above the Narrows?
A. No.

Mr. Riker: The question is objected to on the ground that it is immaterial and irrelevant.
Mr. O'Sullivan: I withdraw the question.

Q. Did the commission conduct a series of float observations?
A. Yes.

Mr. Riker: The same objection.
The Commissioner: Note the objection of counsel for defendants.

Q. And did the commission through its assistants have these float observations charted on maps—plotted on charts or maps?

Mr. Riker: The same objection.
The Commissioner: Note the objection of counsel for defendants.

A. Yes.
Q. Doctor, does the process of decomposition of sewage take place more actively in the warm season than in the cold season in the waters of New York Upper Bay?
A. Yes.

Q. Is that decomposition evidenced in any of our harbor waters by the evolution of putrescent gases?

A. It is.

Q. What are the general characteristics of these gases as to their odor?

A. They are offensive in odor. They suggest the odor of sulphuretted hydrogen, familiarly known to some as the odor
2610 of a rotten egg. It is a strong, penetrating, disagreeable smell.

Q. Will the discharge from the Passaic Valley Trunk Sewer, in the opinion of yourself, increase or diminish the volume and offensiveness of these gases?

A. It will in my opinion increase the volume and offensiveness of the gases which arise from the harbor waters.

Q. What is the most prevalent direction of the wind in the Upper Bay during the warm season, Doctor?

A. From the southwest.

Q. Blowing toward?

A. Blowing across the Upper New York Bay and toward Manhattan and Brooklyn.

Q. I direct your attention to Complainants' Exhibit No. 98, and ask if you know whether or not that exhibit was prepared by the Metropolitan Sewerage Commission?

Mr. Riker: The question is objected to on the ground that it is immaterial and irrelevant.

The Commissioner: Note the objection of counsel for defendants.

A. I believe this collection of blue-print tables was made under my direction in all its details, for and by the Metropolitan Sewerage Commission.

Q. Doctor, I direct your attention to Complainants' Exhibit No. 99, and ask you to state if you know whether or not that exhibit was prepared by the Metropolitan Sewerage Commission?

Mr. Riker: The same objection.

The Commissioner: Note the objection.

A. I believe this collection of blue-print tables was made under my personal direction in all its details, for and by the Metropolitan Sewerage Commission.

Q. I direct your attention to Complainants' Exhibit No. 97, Complainants' Exhibit No. 96, Complainants' Exhibit No. 95, Complainants' Exhibit No. 94, Complainants' Exhibit No. 31, and ask you whether or not the tabulations and tables of averages, as shown in these exhibits, were prepared by the Metropolitan Sewerage Commission?

Mr. Riker: The same objection.

2611 The Commissioner: Note the objection.

A. I have examined them all and I believe this collection of blue-print tables was made under my personal direction in all its details, for and by the Metropolitan Sewerage Commission.

Q. I hand you here, Doctor, Complainants' Exhibits Nos. 32 to 87, both inclusive, and ask you whether or not the plottings of float observations contained in these exhibits were prepared by the Metropolitan Sewerage Commission?

Mr. Riker: The same objection.
The Commissioner: Note the objection.

A. I have examined them and I believe that this collection of blue-print tables was made under my personal direction in all its details, for and by the Metropolitan Sewerage Commission.

Q. The report of the Metropolitan Sewerage Commission of New York, which you stated previously had been filed in the Mayor's office, and dated April 30, 1910, has it been certified to by the Mayor's office?

A. It has.

Mr. O'Sullivan: I offer this report, being a report of the Metropolitan Sewerage Commission of New York, dated April 30, 1910, and ask that it be marked Complainants' Exhibit No. 143.

Cross-examination by Mr. Riker:

Q. When you say that this report has been certified, do you know the signature of Mr. Mathews?

A. I know it from the communication I have in my pocket.

Q. Did you ever see him write his name?

A. No.

Mr. Riker: The offer is objected to on the ground that the book produced is not certified in such a way as to make it competent evidence in any court, and that it is irrelevant, immaterial and incompetent evidence, and that in so far as it purports to contain a statement of matters of fact, it is not the proper way to prove such matters, and in so far as it purports to contain matters of opinion
2612 it is not the proper or legal way to prove such opinions. It is further objected to on the ground that it is not the best evidence of the matters that it purports to contain.

The Commissioner: Note the objection of counsel for defendants.
Received and marked Complainants' Exhibit No. 143.
Received and marked Complainants' Exhibit No. 143.

Direct examination by Mr. O'Sullivan (resumed):

Q. Doctor Soper, from the scientific data accumulated by the Metropolitan Sewerage Commission relative to the digestive capacity of New York Upper Bay, what dangers do you apprehend from the discharge of the Passaic Valley Sewage at Robbins Reef, taking into account the quantity and quality of that sewage at the time of discharge?

Mr. Riker: The question is objected to on the ground that opinion evidence upon matters not shown in the case by proof, but

purporting to be matters before a commission which is not a party to this suit is irrelevant, immaterial and incompetent.

The Commissioner: Note the objection of counsel for defendants.

A. In my opinion the discharge of the Passaic Valley sewage would not only produce serious local nuisances, but would aid and aggravate all the injurious consequences which now exist in the Upper Bay, and to some extent those which exist in the lower Hudson and East Rivers from the discharge of sewage which occurs.

Q. Doctor Soper, did the commission cause to be plotted the oxygen averages for the year 1909 and the year 1911?

A. Yes.

Q. Have you got such plottings with you?

A. Yes.

Q. Will you produce them, Doctor?

A. Yes.

(The witness states that he will produce these later.)

Q. I understood you had maps showing plottings for the oxygen averages of those two years, 1909 and 1911, in approximately similar locations?

A. I have not that in shape for you. I have many other things from which you can obtain that information.

Q. Doctor Soper, did the Metropolitan Sewerage Commis-
2613 sion prepare a map showing the distances from the point proposed for the outfall of the Passaic Valley Trunk Sewer, showing the distance between that point and other points in the Upper Bay?

A. It did.

Q. Have you got such a map with you?

A. I have and present it herewith.

Q. What does this map show, Doctor. Describe the map itself, what it shows?

A. This is a standard chart of New York Harbor, the Upper Bay and Narrows, issued by the United States Coast and Geodetic Survey, and known as an anchorage chart. The scale is 1 to 10,000. The original chart has had various colors and lines applied to it under my personal direction. The object of adding the lines and colors has been to facilitate an understanding of the proposed location of the Passaic Valley Sewer outfall, with respect to the channels of the harbor, the shallows, the boundary between the State of New York and the State of New Jersey, the officially adopted pierhead and bulkhead lines and the distances from the outfall to various points on land in the State of New York and the State of New Jersey.

Mr. O'Sullivan: I offer the map just described by this witness in evidence and ask that it be marked Complainants' Exhibit No. 144 in evidence.

Mr. Riker: The offer is objected to as immaterial, irrelevant and incompetent.

The Commissioner: Note the objection of counsel for defendants. Received and marked Complainants' Exhibit No. 144.

The Witness: In locating the proposed outfall of the Passaic Valley Sewer the information is contained in the report of the Passaic Valley Sewerage Commissioners of 1908. In locating the pierhead and bulkhead lines, information was obtained from the corps of engineers of the United State Army Bureau, known as the Harbor Line Board of New York. In locating the state line, I sent a man to Albany to consult and examine the original agreement between the State of New York and the State of New Jersey, upon which
2614 the state line is officially designated. That has been plotted on this chart and going with the chart is this letter which will enable anyone to confirm the accuracy of location of the boundary between the two states.

Cross-examination by Mr. Riker:

Q. Before, Doctor, reading the letter into the record, if that is what you propose to do, I would like to examine *on* the letter.

Mr. O'Sullivan: I offer in conjunction with this map letter signed by Edward Lazausky, the secretary of state, in relation to the map, and as a certification of the accuracy of certain matters plotted on the map.

Mr. Riker: The offer is objected to on the ground that it is immaterial, irrelevant and incompetent for the reason that it refers to a letter which is no part of the exhibit as presented, and the exhibit is incompetent without the letter.

The Commissioner: Note the objection of counsel for defendants.

Mr. O'Sullivan: In conjunction with this letter I also offer, in reply to Mr. Riker's objection a copy of the original letter addressed to the Secretary of State, the Honorable Edward Lazausky, which will be furnished by Mr. Soper a little later.

Mr. Riker: You say you now offer it? Counsel for defendants fails to see the offer. I cannot answer the offer until the offer is actually made.

(Said copy of letter is to be produced by the witness later.)

Direct examination by Mr. O'Sullivan (resumed):

Q. What were you describing, some of the matters as to what it shows?

A. The chart shows by dark blue color the channel of the harbor. In fact, the channels of the harbor are comprised within the limits of the chart which are 35 feet or more in depth. Water 35 feet in depth and over is colored dark blue. In lighter blue are the waters from 25 to 35 feet in depth. In a light drab water from 18 feet to
2615 25 feet in depth, and more shallow water in a somewhat darker hue of the same color. Parks are indicated on the chart by green colored areas. Parks can be observed on the Brooklyn shore and the Staten Island shore. Green also are the United States Government reservations at Governors Island, Liberty Island or Bedloes Island, as it is still known in the Coast Survey, and Ellis Island, where the United States Government has its immigration station.

The other land areas are colored buff color. The line of the proposed Passaic Valley Sewer outfall, as far as the outfall and its connecting sewer can be comprised on the map, are indicated by broken red lines, and there are many points of interest on the chart which I need not probably call attention to.

Q. What other reports has the commission made since April 30, 1910?

Mr. Riker: The question is objected to as immaterial, irrelevant and incompetent.

The Commissioner: Note the objection of counsel for defendants.

A. A report on the proposed discharge of sewage from the Passaic Valley Sewer of New Jersey, dated May 3rd, 1910. A report on the proposed discharge of sewage from the Bronx Valley Sewer, dated July 25th, 1910. A preliminary report on the disposal of New York sewage. A study of the collection of the sewage of New York City to a central point for disposal, dated September, 1911. Preliminary report on the disposal of New York sewage, No. 2. Description of the four principal drainage divisions of that part of the Metropolitan Sewerage District which lies in New York State, November, 1911. Preliminary reports on disposal of New York sewage, No. 3. Study of the collection and disposal of the sewage of the Jamaica Bay division, November, 1911.

Mr. O'Sullivan: I offer these reports in evidence as described by this witness, and ask that the report of the Metropolitan Sewerage Commission of May 23, 1910, be marked Complainants' Exhibit No. 145.

Mr. Riker: One moment, are you offering them separately; there is one I am not going to object to.

2616 Cross-examination by Mr. Riker:

Q. Where is the original of this report?

A. What is the date of it?

Q. The report of May 23, 1910?

A. The report that you have in your hand is like the other reports of the commission in its original form.

Q. I still press the question; where, if you know, is the original of this report?

A. Perhaps you would like to have me explain about these originals.

Q. No, I would like to have you answer my question, that is all I care for?

A. That is an original.

Q. Is there an original report signed by the handwriting of the commissioners?

A. I think there is in the commission's record, filed with the commission's record, I think.

Q. And not transmitted to the Mayor?

A. No.

Q. Where are the records?

A. What has been transmitted to the Mayor is a printed copy of the commission's report. The commission always transmits to the Mayor printed copies of its reports.

Q. Not signed by the commissioners?

A. The names of the commissioners are appended, not signed by hand.

Q. Then you do not transmit the report, an original signed by the commissioners in their handwriting?

A. In their handwriting, no.

Mr. Riker: This paper is objected to. The offer is objected to on the ground that it is immaterial and incompetent. That it is secondary evidence. The best evidence—the absence of the best evidence not being accounted for in the cause.

The Commissioner: Note the objection of counsel for defendants. Received and marked Complainants' Exhibit No. 145.

At 1 P. M., adjourned for noon recess until 2 P. M.

2617 CORPORATION COUNSEL'S OFFICE,
NEW YORK, June 27, 1912—2 o'clock p. m.

GEORGE A. SOPER, a witness on behalf of Complainants, recalled for further examination, testified as follows:

Mr. O'Sullivan: I offer in evidence the report of the Metropolitan Sewerage Commission of New York, dated July 25, 1910, which has been produced by this witness, and ask that it be marked Complainants' Exhibit No. 146 in evidence.

Mr. Riker: No objection to that.

The Commissioner: Received and marked Complainants' Exhibit No. 146.

Marked Complainants' Exhibit No. 146.

Mr. O'Sullivan: I offer in evidence the preliminary report on the disposal of New York sewage by the Metropolitan Sewerage Commission of New York, dated September, 1911, and produced by this witness, and described by him—I offer that and ask that it be marked Complainants' Exhibit No. 147 in evidence.

Mr. Riker: The offer is objected to as being immaterial, incompetent and irrelevant and not properly authenticated or proved in the cause.

The Commissioner: Note the objection of counsel for defendants. Received and marked Complainants' Exhibit No. 147.

Marked Complainants' Exhibit No. 147.

Mr. O'Sullivan: I offer in evidence No. 2 of the preliminary reports on the disposal of New York sewage, made by the Metropolitan Sewerage Commission of New York, produced by this witness and dated November, 1911, and ask that it be marked Complainants' Exhibit No. 148 in evidence.

Mr. Riker: That offer is objected to for the reasons stated on the last offer.

2618 The Commissioner: Note the objection of counsel for defendants. Received and marked Complainants' Exhibit No. 148.

Marked Complainants' Exhibit No. 148.

Mr. O'Sullivan: I offer the third of the preliminary reports, being a study of the collection and disposal of the Jamaica Bay division, made by the Metropolitan Sewerage Commission of New York, produced by this witness, the president of that commission, and described by him, and dated November, 1911, and ask that it be marked Complainants' Exhibit No. 149.

Mr. Riker: The offer is objected to on the same grounds as to the last two exhibits.

The Commissioner: Note the objection of counsel for defendants. Received and marked Complainants' Exhibit No. 149.

Marked Complainants' Exhibit No. 149.

Direct examination by Mr. O'Sullivan (resumed):

Q. Doctor Soper, did the Metropolitan Sewerage Commission of New York have prepared maps showing the plottings of the oxygen percentages of the oxygen determinations made by that commission for the year 1909?

Mr. Riker: I object. It is immaterial, irrelevant and incompetent.

The Commissioner: Note the objection of counsel for defendants.

A. Yes, there were plottings of the oxygen figures for 1909, relating to the period between June 21 and July 26. Those plottings are designed to show the points from which the samples were collected, the percentage of saturation of dissolved oxygen found at various points, the direction of the currents at the points and the number of samples taken at those various points. These plottings have been made on large maps and reduced by photographic means for reproduction in the forthcoming report of the commission on the sanitary condition of the harbor and the degree of cleanness suitable for it.

Q. Have you got with you the plottings that you have described for the period that you have just testified to?

A. I have.

2619 (Witness produces chart.)

Mr. O'Sullivan: I offer the plottings on this reduced map in evidence as described by this witness and ask that it be marked Complainants' Exhibit No. 150 in evidence.

Cross-examination by Mr. Riker:

Q. Did you make this map, Doctor?

A. The map was made under my immediate direction.

Q. By whom?

A. The draftsman did the drafting of it; Julius Bean and Company did the printing. I may say the map was made by me with the assistance of Mr. Max L. Berrey, and reproduced by the lithographer whom I have mentioned.

Q. What part of the map was done by you?

A. The size and scale, the information to be put upon it, the manner of placing the information, the manner of reproduction, the selection of the colors, the examination of the drafting as it proceeded, the composition of all the reading matter, the size of the lettering and other symbols employed, and the examination of the result to see if it agreed with the data from which it was made.

Q. Where did you get the data?

A. The data, so far as it relates to the map itself, the basis of the map, I obtained from a United States Coast and Geodetic Survey chart, No. 120. The analytical data was collected by Doctor Parsons under my direction as to where to go to get the samples and what method of analysis to employ, how to report the results, and other details relating to the times when the samples were collected and other details. I think that will cover the question.

Q. And data were furnished to you by Doctor Parsons as they appear on this map?

A. The data as they appear on this map were taken from another map which was prepared from that information. I may say, if you wish any further information in that line, that the data indicated upon this map has been tabulated and all recorded in detail in the form of blue-prints already in evidence. This is a graphic representation of information already in evidence.

Q. And in so far as it contains analytical data it is copied
2620 from another map?

A. This is a photographic representation of a map.

Q. That is the map that you have been testifying to as having been made under your direction, is it not?

A. It is a map that I have testified was made by me with the assistance of Mr. Berrey.

Q. Well, what actual work in the way of delineation did you do on the original map in evidence?

A. None on the original work of delineation beyond what I have testified to.

Q. And when you say you made the map you mean you furnished some of the data, is that what you mean?

A. I mean what I have testified to in detail. If you wish to know I will ask the stenographer to repeat it, to read my reply a moment ago.

Q. Well, you do not mean anything else than what you have testified to when you say that you made this map?

A. That is an assertion; it is not a question.

Q. I am not on the witness stand, Doctor. Suppose you answer it.

A. If that is a question I will.

Q. It is a question.

A. I mean what I have testified to a moment ago.

Q. When you say that you have made this map, you do not mean to say, do you, that you have actually done the manual work on it at all?

A. Manual work I have not done on this map.

Q. And the making of the map, by the making of the map you

mean you furnished the detail and nothing else, is that what you mean?

A. I mean more than that. I furnished the plan of it and saw to it that the plan was carried out strictly in accordance with my instructions.

Q. Now, the red figures that are put on this map, did you furnish those?

A. I did.

Q. From what source did you get those figures?

A. From tables which are already in evidence in this case.

Q. Now, which table contains those figures?

A. Complainants' Exhibit No. 31 and Complainants' Exhibit No. 97.

Q. And you put onto this map all the data that are con-
2621 tained in those two exhibits?

A. All that the dimensions of the map permitted, that were collected between June 21 and July 26, 1909. Some analyses were made with water collected beyond the limits of this map. They are not included, naturally.

Q. And these are not averages that are contained on the map?

A. Yes, I explained in my testimony a moment ago that they were averages.

Q. Are those averages contained in the exhibits that you have referred to?

A. Those averages are contained in Exhibit No. 97.

Q. Then the figures that are in red are taken from Exhibit No. 97?

A. They are taken from Exhibit No. 97.

Q. And not from Exhibit No. 31?

A. They are in accordance and in agreement with the figures contained in No. 31. The figures in No. 97 are averages of figures contained in No. 31. The manner of making those averages is plainly indicated in No. 97.

Q. Did you make the averages contained in No. 97?

A. They were made by Doctor Parsons, as I have said.

Q. Then they were not made by you?

A. The averages were not made by me.

Q. Nor the original observations, were they made by you?

A. They were not made by me beyond what I have said.

Q. And of your own knowledge do you know anything about the accuracy of the original observations?

A. I have no reason to doubt that they were taken in accordance with my instructions, and I believe that they represent accurately the facts.

Q. What knowledge have you as to whether or not they accurately represent the facts?

A. I have such knowledge as comes from confidence in the fidelity of my assistant in carrying out his instructions. He is a man of high scientific attainments, a professional man of excellent standing, and has been known to me for many years as an accurate conscientious worker.

Q. Have you stated your whole knowledge now of the accuracy of those data?

A. I have stated the knowledge which I have supposed
2622 you desired in asking me the question.

Q. I now ask you whether you have stated your whole knowledge of the accuracy of the data in question?

A. It would take me considerable time to answer that question. I should have to review the circumstances, which are now three years past, in order to answer that very searching and exhaustive question.

Q. You do not think the answer yes or no would answer that question?

A. I should prefer to answer it as I have already answered it.

Q. I again ask you the question whether you have exhausted—whether you have stated all the knowledge you have relative to the accuracy of the data in question?

A. You wish me to take sufficient time then, I suppose to answer.

Q. I want you to answer yes or no. That is the answer it calls for. Cannot you answer yes or no?

A. I have explained to you that the circumstances as to which you are asking an immediate answer and description occurred many of them three years ago. I have had no occasion to review the matter since that time, and if you insist on a categorical answer you must permit me to have time enough to prepare for the same.

(Question repeated by the stenographer.)

Mr. Riker: Mr. Commissioner, I shall have to insist on an answer to that question. The question calls for yes or no, and the witness ought to answer it.

The Witness: I should answer it, if it will be acceptable to you, that I have given substantially all. I am trying now to remember to what extent and by whom these averages were checked. That would be an additional piece of assurance as to the accuracy of them. Waiving that point I can answer you perhaps with the brevity that you desire.

Q. Will you answer the question?

A. Yes.

Q. Where is the original of this map which is here stated to be reproduced on a smaller scale?

A. The original is in the hands of the printer.

Mr. Riker: The offer is objected to on the ground that it
2623 does not purport to be the original map, which is the best evidence, and on the further ground that it is immaterial irrelevant and incompetent for the reason that the data supposed to be included in the exhibit is not within the knowledge of this witness.

The Commissioner: Note the objection of counsel for defendants.

Direct examination by Mr. O'Sullivan (resumed):

Q. Is the Metropolitan Sewerage Commission of New York a state commission?

A. It is a state and city commission and has been so declared by the courts.

Q. Is the original of this map a part of the records of that commission?

A. It is.

Q. Is this a correct copy of the original?

A. I believe it to be.

Mr. O'Sullivan: I renew my offer, and ask that it be marked Complainants' Exhibit No. 150 in evidence.

Cross-examination by Mr. Riker:

Q. You say it is a correct copy. Did not you say it was a reduction in size?

A. Oh, yes.

Q. Then it is not a correct copy?

A. Yes.

Mr. Riker: I renew my objection.

The Commissioner: Note the objection.

Received and marked Complainants' Exhibit No. 150.

Direct examination by Mr. O'Sullivan (resumed):

Q. Did the Metropolitan Sewerage Commission of New York prepare any other map or plotting showing these oxygen averages during the year 1909 or for the year 1909?

A. The same data and other data relating to 1909 have been plotted on a map which I hand you herewith.

Q. What is the other data, Doctor?

A. The other data relates to the analyses made at other periods than the period included by the first map. The data in the map I have last handed you were all collected in 1909. The period covered in the first represents about a month during warm weather.

2024 Q. Does this plotted map which you now hand me represent the average oxygen content in the waters for the year 1909?

A. No, for the period indicated in the exhibit. If you wish, I will tell you.

Q. I want you to describe it.

A. All analyses made by the Sewerage Commission in 1909 are grouped irrespective of the period of year in this chart. The plan of making the chart, the scale, the system of representing the data, the method of collecting and collating the data, and the part which I personally had in the preparation of this map are uniform with what I have testified to in the first map handed to you.

Mr. O'Sullivan: I offer the map just described by this witness in evidence and ask that it be marked Complainants' Exhibit No. 151 in evidence.

Cross-examination by Mr. Riker:

Q. Where is the additional data that has gone into the making of this chart found?

A. In Complainants' Exhibit No. 31 and Complainants' Exhibit No. 97.

Q. In the form in which it is put upon this chart in which of the exhibits that you have referred to can we find it?

A. Exibit No. 97.

You may remember that No. 97 contains averages of dissolved oxygen in the year 1909. It summarizes tables 9 to 15, which is represented by Exhibit No. 31.

Q. This additional summary or averages are prepared in the same way as the last exhibit?

A. Yes.

Q. You had as much or as little to do with this as the others?

A. Quite so.

Mr. Riker: The offer is objected to on the ground that it is not proved to contain any facts, to present any facts, and for the additional reasons urged against the last offer.

The Commissioner: Note the objection of counsel for defendants. Received and marked Complainants' Exhibit No. 151.

Marked Complainants' Exhibit No. 151.

2625 Direct examination by Mr. O'Sullivan (resumed):

Q. Did the commission cause plottings to be made on any other map relative to their determinations?

A. For 1909 on dissolved oxygen, do you mean?

Q. Dissolved oxygen, yes sir, or for bacteria?

A. Yes. For dissolved oxygen. The dissolved oxygen results were combined in numerous ways, in order that the utmost information might be drawn from the data.

Q. Doctor, will you state, and if you please, produce such maps or charts as show the plotted oxygen, bacterial or other examinations made by the Metropolitan Sewerage Commission of New York during the years 1909 and 1911?

A. I have first to hand you a chart of dissolved oxygen in the water determined from samples collected between June 27 and July 28, 1911. It is to be noted that this period of time corresponds to the period of time two years earlier covered by the dissolved oxygen data indicated on the first map presented in this series a few moments ago. The method of collecting the samples, the person by whom the samples were collected, the method of analysis were the same in each year. The part of the year within which the samples were collected in each case were as nearly the same as practicable. The method of representation is uniform. My personal connection with the work represented by this map is identical with that already described by me in connection with the first map in these series.

Mr. O'Sullivan: I offer the map just described by this witness in evidence and ask that it be marked Complainants' Exhibit No. 152 in evidence.

Cross-examination by Mr. Riker:

Q. Is this the original map?

A. It is not. It is a photographic representation of it for the purposes of publication in the forthcoming report of the commission on the degree of cleanness and sanitary conditions of the harbor waters.

Mr. Riker: The offer is objected to for the same reasons as the last offer.

2626 The Commission: Note the objection of counsel for defendants. Received and marked Complainants' Exhibit No. 152.

Marked Complainants' Exhibit No. 152.

Q. Proceed.

A. It is proper for me to say that the accuracy of these plottings, the accuracy of the averages from which the plottings are made and all other essential facts concerning the use to which the original data is put is susceptible of verification from the original tables of data which have already been put in evidence. I hand you a map showing the numbers of bacteria in the water of New York Harbor as determined by the commission in 1909, with the locations of points from which the samples were collected. The map I refer to is one of the series already described. My connection with the work is as heretofore described in connection with the other maps. All the persons connected with the collection of the samples or analyses, in making of the averages, the same as described for the dissolved oxygen maps already in evidence.

Mr. O'Sullivan: I offer the map relative to the bacteriological determinations of 1909 as described by this witness. I offer it in evidence and ask that it be marked Complainants' Exhibit No. 153 in evidence.

Cross-examination by Mr. Riker:

Q. This is not the original map?

A. It is a photographic reproduction of the original map for the purposes of publication in the forthcoming report of the commission on the sanitary condition of the harbor and the degree of cleanness necessary and sufficient for the water.

Q. That is not the original map?

A. It is a photographic representation of it.

Mr. Riker: The offer is objected to for the same reasons urged on the last offer, and for the further reason that this witness declines to answer questions of counsel.

The Commissioner: Note the objection of counsel for defendants. Received and marked Complainants' Exhibit No. 153.

2627 Marked Complainants' Exhibit No. 153.

Q. Describe the other charts?

A. I hand you a map of a portion of New York Harbor on which there are represented the numbers of bacteria in dredgings from the

surface of the bottom of New York Harbor determined by the commission in 1909. The location of the samples is indicated, and the approximate number of bacteria per gram of water deposit shown. The data has been taken from the tables of summaries of data already put in evidence.

Mr. O'Sullivan: I offer the chart or map just described by this witness and ask that it be marked Complainants' Exhibit No. 154 in evidence.

Cross-examination by Mr. Riker:

Q. Is this the original map?

A. It is a photographic representation for purposes of publication in the report.

Q. Is it the original map?

A. It is a photographic representation.

Mr. Riker: The offer is objected to for all the reasons stated on the last offer.

The Commissioner: Note the objection of counsel for defendants. Received and marked Complainants' Exhibit No. 154.

Marked Complainants' Exhibit No. 154.

Direct examination by Mr. O'Sullivan (resumed):

Q. Proceed..

A. I hand you another map in the series entitled microscopical examination of numbers of bacteria in borings in the bottom of New York Harbor, made by the Sewerage Commission in 1909. The locations of the borings, the result of the examinations are indicated in a way uniform with that shown on the preceding maps of this series.

Mr. O'Sullivan: I offer the map just described by this witness showing the borings in the bottom of New York Harbor, made in the year 1909 by the Metropolitan Sewerage Commission. I offer it in evindence and ask that it be marked Complainants' Exhibit No. 155 in evidence.

2628 Cross-examination by Mr. Riker:

Q. Is it the original map?

A. It is a photographic representation for the purposes of reproduction.

Q. It is not the original map then?

A. It is a photographic representation.

Mr. Riker: The offer is objected to for the same reasons.

The Commissioner: Note the objection. Received and marked Complainants' Exhibit No. 155.

Marked Complainants' Exhibit No. 155.

Direct examination by Mr. O'Sullivan (resumed):

Q. Proceed.

A. I hand you the final map in the series, the last descriptions of

microscopical examinations of dredgings from the surface of the bottom of New York Harbor, made by the commission in 1908 and 1909. The location of the samples, the numbers of the samples and the results of the examinations are indicated graphically.

Mr. O'Sullivan: I offer the chart or map just described by this witness in evidence and ask that it is marked Complainants' Exhibit No. 156 in evidence.

Mr. Riker: The offer is objected to for the same reasons as to the last offer.

The Commissioner: Note the objection. Received and marked Complainants' Exhibit No. 156.

Marked Complainants' Exhibit No. 156.

Q. Dr. Soper, in your testimony relative to the charts or maps you stated that they were prepared for some forthcoming report?

A. Yes.

Q. Have you got a copy of that report with you?

A. I have not the report in final form with me, but I have page proof of the forthcoming report. The title is the present sanitary condition of New York Harbor and the degree of cleanness necessary. The report is in active process of completion. It has passed from the original draft in typewritten form to galley proof, printed form, and from galley proof to page proof, and although it is
2629 still subject to correction, revision and change, the substantial character of the report is clearly indicated by the page proof, and there are many diagrams, tables, and other information contained in it which may be helpful to a clear understanding of the merits of this case. Accompanying the report of the commission and a part of it are reports of various experts consulted by the commission in respect to a list of questions drawn by the commission for the experts to consider.

Mr. O'Sullivan: I offer the report just produced and described by this witness, and ask that it be marked Complainants' Exhibit No. 157 in evidence, and beg to state that later on in its more permanent form I will substitute the more permanent report for this. It will be substantially this report, containing all the basic facts and data in a more finished form, and I would like to substitute that later for this. I offer it now and ask that it be marked Complainants' Exhibit No. 157.

Mr. Riker: Counsel for defendants desires to know whether counsel for complainants proposes to offer an identical piece of evidence with that he now offers.

Mr. O'Sullivan: Counsel for complainants in reply would state that there may possibly be typographical and other errors of that kind in these proof sheets and that the substituted copy that will be offered later on will be submitted to the inspection and examination of counsel for defendants.

Mr. Riker: Counsel for defendants objects to the offer as stated on the ground that the exhibit which is proposed is admittedly not the one that is produced. Further on the ground that the offer is

irrelevant and incompetent and not proved in the cause, and on the statement of the witness contains opinion evidence by so called experts, who have not subjected themselves to cross-examination and whose opinions therefore are immaterial, incompetent and irrelevant and not to be received in this case. It is further objected to on the ground that the paper which is now produced is admittedly not the original and that it is not proved to contain any facts material to the issue in this cause.

2630 The Commissioner: Note the objection of counsel for defendants. Received and marked Complainants' Exhibit No. 157.

Marked Complainants' Exhibit No. 157.

Q. Doctor Soper, just prior to recess you stated that you would produce a letter or copy of a letter which you sent to the Secretary of State, and which elicited the answer that you produced at that time from the Secretary of State. Have you now with you, Doctor, a copy of the letter, a carbon copy, which you caused to be mailed to the Secretary of State of the State of New York?

A. I have, and I hand it to you herewith, marking my signature on the copy. I also hand you letter received in reply.

Mr. O'Sullivan: This witness having now produced a carbon copy of a letter of May 16, 1912, addressed to Edward Lazausky, Secretary of State of the State of New York, and the reply dated May 17, 1912, signed by Edward Lazausky, Secretary of State, and ask that both these letters be made a part of Complainants' Exhibit No. 144.

Marked Complainants' Exhibit Nos. 144A and 144B.

Mr. Riker: The request is objected to on the ground that they do not form a part of the exhibit in question, and for the further reason that they are incompetent in this cause, it not appearing that such an exhibit is evidential under any statute that prevails and governs the action of this court.

The Commissioner: Note the objection of counsel for defendants. Received and marked Complainants' Exhibits Nos. 144A and 144B.

Q. Doctor, have you stated fully your reasons for tracing the discharge of sewage from the contemplated discharge of the Passaic Valley Trunk Sewer into Upper New York Bay near Robbins Reef in full?

A. Yes, in my testimony and in the exhibits which consist of the report of the commission with respect to this very subject of the proposed discharge of sewage from the Passaic Valley Sewer.

Q. Have you got any other maps or blue-prints or diagrams or data that would strengthen the testimony already given in re-
2631 lation to the contemplated pollution from the Passaic Valley Sewer?

Mr. Riker: I object to the question on the ground that it calls for a legal conclusion on the part of this witness.

The Commissioner: Note the objection of counsel for defendants.

A. None that occurs to me now.

Mr. O'Sullivan: Your witness.

Cross-examination by Mr. Riker:

Q. In 1903, when you began your investigation into the general subject of the pollution of New York Harbor, what was the occasion for your interest at that time?

A. The appointment of the New York Bay Pollution Commission.

Q. Do you know with reference to the proposal to construct a trunk sewer in the Passaic Valley discharging into New York Bay whether it was before or after that project was made known?

A. I think it was after.

Q. And was it not in consequence of that that the commission in question was appointed?

—. I do not know.

Q. How long after the publication of it?

A. I do not know.

Q. You do not know of any action by the legislature or any proclamation by the government of the State of New York avowing as the purpose of this commission the prevention of the carrying out of the New Jersey project?

A. I know there was no such statement in the act providing for the creation of the New York Bay Pollution Commission.

Q. How long after the project of New Jersey was made public was this commission established?

A. I do not know.

Q. You have no idea?

A. Yes.

Q. Well, what idea have you on the subject?

A. My idea was it was some months.

Q. A year?

A. I do not know.

Q. Do you think it was a year?

A. No.

Q. Do you think it was not a year?

A. I do.

Q. Your figures of percentages of discharge from the terri-
2632 tory of New Jersey into New York Bay, where did you get them from?

A. I got them from the Passaic Valley Sewerage Commissioners' report.

Q. Of the present discharge of sewage into New York, those figures you got from the report of the Passaic Valley Sewerage Commissioners?

A. I understand you are referring to the discharge of the proposed Passaic Valley Sewer?

Q. No, I am not. I am referring now to the actual discharge from the communities of the State of New Jersey as compared with the communities of the State of New York?

A. Where did I get those data?
Q. Yes.
A. I got them from the United States Census Bureau figures on population, allowing 160 gallons per capita for Manhattan and 125 for Brooklyn.
Q. What communities did you take into account in New Jersey?
A. I took Bayonne and the lower part of Weehawken, Communipaw.
Q. Is that all?
A. Discharging into Upper New York Bay.
Q. Did not you take into account Jersey City?
A. Jersey City does not discharge into Upper New York Bay.
Q. And the figures that you gave of 10 per cent. were of the communities discharging directly into Upper New York Bay?
A. Discharging into Upper New York Bay.
Q. Have you made any figures as to the percentage of communities discharging indirectly into New York Bay?
A. Yes.
Q. What are the percentages of communities compared with those of the State of New York?
A. I have not got the figures with me.
Q. You do not remember what they were?
A. No, I do not remember.
Q. Was the percentage from the State of New Jersey larger or smaller than 10 per cent.?
A. I should say it was probably smaller.
Q. You have been asked your opinion as to the effect of the proposed discharge from the Passaic Valley Sewer into the Upper Bay, and you have given an answer to that inquiry. What proposed discharge did you have in mind in making your answer to that question, or those questions?
2633 A. The proposed discharge as indicated in the report of the Passaic Valley Sewerage Commissioners, to which I referred specifically this morning.
Q. And nothing else?
A. No—something else.
Q. What was that something else?
A. The agreement entered into between the Department of Justice of the United States and the Passaic Valley Sewerage Commissioners in October, 1909. The State of New Jersey is also a party, I think, to that agreement.
Q. And in expressing the opinion which you did, you had that in mind, did you?
A. I did.
Q. And you had in mind the whole of it, did you?
A. Oh, yes.
Q. You had in mind the character of effluent prescribed and described in that stipulation?
A. I had also the character of effluent which I believed would be delivered.

Q. Did you believe that the character of effluent as described in that stipulation would be in fact delivered?

A. No.

Q. Did you disbelieve the carrying into effect of that stipulation by the State of New Jersey and the Passaic Valley Sewerage Commissioners because you believed it was impossible to produce such an effluent?

A. By the means proposed I thought it was highly improbable.

Q. When you say by the means proposed, you refer, do you not, not to the specific devices and processes described in the stipulation?

A. Yes.

Q. You do not refer to other lawful arrangements to accomplish the same result?

A. It seemed improbable to me that anything further would be done.

Q. I think you have said that you understand the State of New Jersey is a party to this stipulation with the United States?

A. Oh, yes.

Q. And you think it is improbable that the State of New Jersey will see that that stipulation is carried into effect?

A. I think it is left to the United States Department of Justice as to whether it shall or not, or the War Department.

Q. That is your interpretation, is it not, of the stipulation?

A. My understanding of this stipulation is that a depart-
2634 ment of the general government is intended to be referee in the matter, and yet it seems to me unlikely that that department's interest will be sufficiently great to insist upon a high degree of purification, particularly if what may appear at the time to be great practical obstacles are developed.

Q. You do not believe that the State of New Jersey, when it stipulates that these results will be obtained, will see that they are obtained?

Mr. O'Sullivan: The question is objected to on the ground that it calls for a psychological discussion on the part of this witness as to what the State of New Jersey contemplates doing.

The Commissioner: Note the objection of counsel for complainants.

A. I am not questioning the good faith of the State of New Jersey, but at the same time the project is of unexampled magnitude. The difficulties are very great. The cost of treating the sewage to any greater degree of perfection than appears absolutely necessary will be very great, and it seems to me that those who are to pass judgment on the matter, according to this agreement, are the Department of Justice of the United States Government, which has comparatively little interest in the subject, and the State of New Jersey itself, which would be put to much greater cost if it did any more than what was absolutely required.

Q. Will you point out in that agreement or stipulation the portion which constitutes any department of the United States Govern-

ment the arbiter with reference to this matter, with the exception of one of the specific stipulations as to the character of the effluent?

A. The United States is to have access—I will correct that—it is not the United States, it is a department, a comparatively small branch or bureau of the general government which is concerned.

Q. Will you point out that in the agreement or stipulation?

A. It is the Department of Justice as I understand it, which compelled the Passaic Valley Sewerage Commissioners and the State of New Jersey to enter into this agreement.

Q. You understand that the United States Government can
2635 compel the State of New Jersey to enter into an agreement?

A. As I understand it the Department of Justice became a party to this suit of the State of New York against the State of New Jersey and the Passaic Valley Sewerage Commissioners.

Q. And not the United States, but the Department of Justice?

A. The Department of Justice.

Q. That is your understanding of it, and not the United States?

A. It may have been done in the name of the United States.

Q. Well, if it was done in the name of the United States, don't you think that the Department of Justice was assuming authority which it had not, and that it was really the Department of Justice and not the United States that was sought to be made a party to this proceeding?

A. Nothing that I have said should be misconstrued to that end.

Q. You said you do not think that?

A. I do not think what you have intimated is correct.

Q. Will you go on and point out where any department of the United States Government is made an arbiter in this stipulation with the exception of one specific item in the stipulation as to results?

A. I am looking for that one particularly.

Q. It is No. 2 in parenthesis?

A. That is the one I had in mind.

Q. Will you point out any other?

A. No.

Q. Still you say a department of the United States Government is made the arbiter as to whether the agreement is carried into effect or not?

A. I read that paragraph 2 of the second paragraph to mean that very thing, so far as it goes.

Q. That is the only thing, however, that you can point out as justifying your belief that the Department of Justice, a department of the United States Government is made an arbiter as to the carrying out of this agreement?

A. Yes.

Q. So that you have not taken into account the character of the effluent as described in this stipulation, being Complainants'
2636 Exhibit No. 135, because you believe that it will not be carried out in fact?

A. I believe it will not be carried out in fact.

Q. That is the reason why you have not taken it into consideration?

A. I have taken it into consideration.

Q. Now, what consideration have you given to it with reference to the opinion that you have expressed in this case?

A. I have said that I do not think the interests of the government were sufficiently great to ask the Passaic Valley to treat its sewage to as high as degree as would be desirable from the standpoint of New York, for example.

Q. Well, I know, but with reference to the effluent described in this particular stipulation, what consideration did you give to that as one of the factors in the problem to determine the effect of that discharge upon the waters of the Bay of New York?

A. I gave it this consideration, provided the sewage was treated to the extent indicated here, it would still be a nuisance.

Q. Now, will you point out in what respect the effluent as described in this stipulation will be a nuisance in the waters of the Bay of New York?

A. I should expect this effluent to rise to the surface and produce discoloration, turbidity, objectionable odors.

Q. In that answer do you bear in mind that the stipulation prescribes in the seventh paragraph for the practical absence on the surface of New York Bay of any grease or color due to the Passaic Valley sewage?

A. Yes, I had that in mind, but the definition of the term "practical absence" is left blank. What might be very objectionable from one point of view might not be from another.

Q. And you think there will be turbidity, notwithstanding the stipulation provides that there will be absence in New York Bay of suspended particles coming from the Passaic Valley sewage?

A. Quite so, turbidity and visible particles are quite different things.

2637 Q. And that there will be odor notwithstanding the stipulation that there will be absence of odors in New York Bay due to the putrefaction of organic matter contained in the Passaic Valley sewage thus discharged. That is the third of the sub-stipulations?

A. There may be odors of a disagreeable character not due to the putrefaction of organic substances.

Q. What will they be due to?

A. Sewage before it putrefies has a disagreeable odor.

Q. You think, then, that at the point of discharge there is likely to be odor from the sewage there discharged before it begins to putrefy?

A. I believe there will be odors due chiefly to gases of decomposition at that point.

Q. And those are the odors that you had in mind as likely to be objectionable?

A. Those are the odors that I have in mind as likely to be objectionable at that point.

Q. And you think those will be present, even though the stipulation is carried into effect, do you?

A. I think those will be present.

Q. Bearing in mind that it provides there shall be no odors, due to putrefaction of organic matter?

A. That point is difficult to establish, exceedingly difficult to establish, where the odor comes from, so far as many persons are concerned. Personally I believe there will be odor directly over the outfall, but if the currents carry the sewage for the distance of a quarter of a mile or so, and the odors there rise to the surface, it would be difficult to establish where they came from.

Q. You are interjecting into the stipulation, are you not, a question of ability to prove the presence of the odor in place of the stipulation that there shall be no odor?

A. I am endeavoring to regard the matter in a perfectly sensible and practical way.

Q. In a way that does or does not comport and agree with the terms of the stipulation, are you seeking to do that?

A. I am seeking to express to you an opinion which I have formed as to the conditions likely to occur at the outfall or in its vicinity.

2638 Q. Your belief is, is it not, Doctor Soper, that as a matter of fact this stipulation will not be carried out?

A. That is so.

Q. And your opinion is based, upon that belief, is it not?

A. It is.

Mr. Riker: That is all.

Mr. O'Sullivan: It is feasible to carry out the stipulations set forth in that stipulation between the State of New Jersey and the federal government?

The Witness: It is not, in my opinion, no, it is not.

EMIL KUICHLING, a witness called on behalf of Complainants, recalled for further examination, testified as follows:

Direct examination by Mr. O'Sullivan (resumed):

Q. Mr. Kuichling, Mr. Fuertes testified that he took the data relative to populations which he set forth in Table 1 in the testimony from data which he acquired from your testimony when you were on the stand before. Now, I ask you where you got the population data for the year 1910, as set forth in Table 1 of Mr. Fuertes?

A. Those figures were obtained directly from the United States Census reports for the state of New York and New Jersey which were furnished to me in response to a letter written to the department for a copy thereof.

Q. And where did you get the populations for the year 1940?

A. The figures relating to the Passaic Valley Sewerage District were taken from the report of the Passaic Valley Sewerage Commissioners for the year 1908. Those relating to the city of New

York were taken partly from the report of the Metropolitan Sewerage Commission and in part from estimates made by myself in conjunction with H. de Berkeley Parsons, a member of that commission. The estimates for the year 1940, relating to the territory in New Jersey, in the Metropolitan Sewerage District, outside of the Passaic Valley District, were made in like manner by Mr. Parsons and myself.

Q. Mr. Kuichling, have you read the hypothetical question in this case?

2639 A. I have.

Q. And examined personally the exhibits that are enumerated in that hypothetical question which you heard read to Mr. Eddy?

A. Yes, sir. Examined all the exhibits mentioned.

Q. Now, taking all the facts and circumstances of record in this case, and facts observed by you into your full consideration, what in your opinion will be the results of the contemplated discharge from the Passaic Valley Trunk Sewer outlet into New York Upper Bay in the vicinity of Robbins Reef on the harbor waters and tidal waters of New York Harbor, under present existing conditions and under prospective conditions on or about the year 1940, and during the intervening period between the present year, 1912, and the year 1940?

Mr. Riker: The question is objected to on the grounds stated in my objection to the use of this question to the last expert witness to whom it was propounded.

The Commissioner: Note the objection of counsel for defendants.

A. My opinion is that the operation of the Passaic Valley Trunk Sewer as proposed by the commission will result in a nuisance in the vicinity of Robbins Reef Light, and that the same will be perceived in the warm season, not only by people in vessels, but also by people residing on the shores of the Upper Bay, from the Narrows to Governors Island, and probably also beyond those limits at times.

Mr. O'Sullivan: Your witness.

Cross-examination by Mr. Riker:

Q. What was the occasion of your entering upon the study of the waters of the harbor of New York?

A. I have made studies of the water of New York Harbor for a great many years. I think the first occasion was while I was engineer for the New York State Board of Health, about 1881 or 1882, when I was called upon to examine a number of localities in New York Harbor, of which some complaint had been made. Later on, came the pollution of the East River by the Standard Oil Company, rather, a certain oil refinery at Newtown Creek, and

2640 then another investigation was made by me. After that a series of complaints came in from nuisance created by the discharge of sewage in the Upper East River and Long Island Sound. One of them, I remember, was the nuisance alleged to be created by

the discharge of the sewage of New Rochelle near Glen Island, causing offensive odors. Then came some other similar cases on the Lower Hudson River.

Q. Have you been connected with the Metropolitan Sewerage Commission?

A. No, sir; not officially. I have not been employed by them at all.

Q. By whom are you employed to give your expert testimony here?

A. I have been employed by the Corporation Counsel of the City of New York.

Q. For how long?

A. Since last July, about eleven months now.

Q. And you have been employed to testify on behalf of the complainants in this suit?

A. I presumed I would be called upon to testify. I did not know whether or not I would be called upon to testify when I first entered into the work.

Q. Now, you have testified at considerable length, I think, Mr. Kuichling, with reference to the project of the Passaic Valley Sewerage Commissioners, have you done so?

A. I think so, yes, sir.

Q. At considerable length?

A. Yes sir, I should say quite a number of pages of matter.

Q. And in investigating the project of the Passaic Valley Sewerage Commissioners, what did you do to determine what the project is?

A. I read the report of the Passaic Valley Sewerage Commissioners published in 1908, and I had previously read the reports made some years ago on the same project by Mr. Fteily and Mr. Jacobson, who had made reports on this project. I had also read of the project in the technical journals and had seen abstracts printed in these journals of reports made by Mr. Hering and Mr. Fuller, I think. But the principal source of information to which I have referred in my testimony has been the report of the Passaic Valley Sewerage Commissioners published in 1908.

Q. You have not consulted any document of later date than that?

A. I have not seen any, sir.

2641 Q. Have you made any endeavor to see any?

A. Yes.

Q. When did you make an endeavor?

A. I made an endeavor to in Newark. I asked Mr. Sherrerd.

Q. Who is Mr. Sherrerd?

A. Mr. Sherrerd is, I think, the engineer of the Board of Public Works of the City of Newark, also engineer of the New Jersey Water Supply Commission, if I am not mistaken.

Q. I think he is.

A. And I asked him for information on the subject and he could not give me any further than was published.

Q. When did you ask him for that?

A. It was in August last, August, 1911.

Q. Well, did you make any endeavor to see Mr. Gibson, Secretary of the Passaic Valley Sewerage Commissioners, did you make any inquiries of him?

A. No, I did not. I did of Mr. Edlow Harrison, then engineer of the commissioners. I asked him if any reports were out subsequent to the one of 1908, and I was informed by him that no reports had been published since that time. There may have been in the newspapers, but I mean reports in book form.

Q. Would you be surprised to know that there was an actual contract submitted to the various municipalities which were expected to contract for the construction of a sewer.

A. No, I heard of the existence of such a contract, but I did not see a copy of it.

Q. Did you inquire for one?

A. Yes, I did. I was curious to know what the terms were and I tried to get a copy.

Q. Of whom did you inquire?

A. I asked Mr. Harrison for a copy.

Q. And he did not give you one?

A. I think he promised to give me one but the promise never materialized.

Q. Would you like to see one?

A. I would, really.

Q. I will be very happy to furnish you one?

A. I will be happy to have it.

Q. Do you know it has been actually executed by certain municipalities?

A. I heard that.

Q. Have you made any inquiry on that?

A. I have not.

2642 Q. Don't you think it an important matter before testifying in this suit to know exactly what the proposal is on which you are asked to testify?

A. I assumed it was substantially in accordance with the plans as published.

Q. Why did you assume that?

A. Well, I had no other ground to proceed upon.

Q. All your assumptions in your expert testimony are based upon a similar foundation, are they?

A. No, sir.

Q. Have you read the act constituting the Passaic Valley Sewerage District?

A. I don't know whether I read that act or not. If it was contained in the report of 1908 I did so. If it was not contained in that report I think I remember reading some reference to it in the technical journals.

Q. And do you remember whether or not it defined the territory in which the district was set up?

A. I have not a very clear recollection of the act now. I have only the report of 1908 more definitely in mind.

Q. You did not investigate and determine whether or not the municipalities which are included in the report of 1908, and upon which a part of your testimony has been based, were or were not all included in the district as defined by the legislative act?

A. No, I read recently that there were extensions to the territory. They were proposing to take in additional areas, and I have also read that some of the communities within the proposed district had declined to enter.

Q. Yes, and you say you have read whatever legislation is included by copy in the report of 1908?

A. I think so.

Q. Do you remember the act of 1907 authorized the commission to construct a sewer by contract with the municipalities, as having been contained in that report?

A. I do not remember that. I paid no attention to the legal terms there.

Q. You do not know then whether or not a sewer could under that act be constructed by the Passaic Valley Sewerage Commissioners for as few as two of the communities named in the district?

A. No, I do not.

Q. Would the size of the proposed sewer to be constructed
2643 have any bearing upon your expert testimony in this case?

A. Yes, it would, necessarily.

Q. Well, your opinion has been based, as I remember it, upon the assumption that there were thirty communities included in the project?

A. Yes, sir, as set forth in the report of 1908.

Q. Suppose the actual contract calls for the performance of the work by the commissioners on behalf of only fifteen of those municipalities, in your judgment would that affect the results which you have testified to?

A. It would depend very much on which fifteen were included.

Q. It would depend in what respect, in degree or in kind?

A. In both, both degree and kind.

Q. And if those that are named in the report and upon which you have based your testimony in this case are not parties to the contract, you think whether or not that affects the result of your testimony depends upon what municipalities are included within the fifteen which have gone in, and what are included in the fifteen that are taken out?

A. Yes, sir; I should say so.

Q. And you can conceive of conditions under which the refusal of fifteen of the municipalities to stay out would have no appreciable effect on your testimony?

A. Yes sir.

Q. What are the fifteen which you think could stay out without having an appreciable effect on your testimony?

A. I should name such communities as Acquackanonk, possibly Prospect Park, a portion of Saddle River, and a number of the small districts.

Q. Would you include Montclair in it?

A. No, I do not believe I would include Montclair.
Q. Would you include East Orange in it?
A. I should not like to include East Orange.
Q. Would you like to include the City of Orange in it?
A. No, I would consider the City of Orange as one that is of rather large calibre.
Q. What do you say of the town of Bloomfield?
A. Bloomfield is to me a little doubtful. It is one of the small districts, population 15,000 in 1910.
2644 Q. Well, what about Glen Ridge?
A. I do not remember about Glen Ridge more definitely. I should say Glen Ridge might be omitted also, being a small town.
Q. It all depends upon the actual population which is included?
A. Yes, the population and the industries. I lay special stress upon the industry development of that region.
Q. Your testimony as to prospective populations, so far as scientific accuracy is concerned, would be of comparatively little value would, it not, if you exclude a very considerable portion of the district on which you were testifying?
A. I should say no to that question. It would have value depending upon the size of the communities included or excluded, either way.
Q. It would necessitate, however, a recalculation of results?
A. Yes, to some extent.
Q. Well, as to most of the results estimated by you for 1940, would not the reduction of the population included within the district under the census of 1910 make it necessary to recalculate almost all the figures that you have put in in the testimony?
A. No. I think it would not require the recalculation of all the results. That would depend entirely on the basis that is adopted for the interception of the sewage.
Q. Now, in your testimony you were disposed to question the rate of prospective growth of the City of Newark. Do you remember that?
A. Yes, sir.
Q. How much territory in square miles is actually included within the limits of the City of Newark?
A. The City of Newark, in the report of the Passaic Valley Sewerage Commission of 1908 is credited with an area of 23.77 square miles, of which 21.3 square miles is said to be tributary to the proposed trunk sewer.
Q. Now, your criticism of the estimate of the percentage of growth in the City of Newark was based upon the growths in the preceding decade, was it not?
A. Yes, sir.
Q. Do you know what territory has been annexed to the
2645 City of Newark in the preceding decade?
A. I know there were one or two adjacent boroughs annexed.
Q. Do you know how much population?
A. No, sir; I do not except as given by the census reports.

Q. Do you know whether or not the comparison of percentages with the preceding decade was on the basis of including the population so annexed or not?

A. Yes, the annexed population was included in both of those decennial censuses.

Q. You took the decades preceding for a comparison?

A. Yes.

Q. Do you know what was annexed in the preceding decade to the City of Newark?

A. I do not quite remember now. It was somewhat smaller in population, in number of population. That is, what was annexed in the succeeding decade. That is, there were more people annexed in the decade between 1900 and 1910 than there were between 1890 and 1900. My recollection may be a little in error on it.

Q. And those annexations in both decades affected the percentage of growth of the city?

A. Yes, sir, they do in all cities.

Q. Now, in estimating the growth for the future, do you know whether or not any element of annexed territory has been incorporated in the estimate of the Passaic Valley Sewerage Commissioners?

A. I assume that there has been some.

Q. Why do you assume that?

A. Why, they show a growth of the city, and in some, I think in all other cases, they show a larger growth. They do not state specifically that they have not limited the area to a certain amount. They give no reasons, and you simply draw an inference that the city will grow, in their estimate, as other cities in this country and other countries grow, by enlarging their boundaries, which is a natural thing.

Q. You are familiar with the City of Newark, are you?

A. I know the city, I have been there a number of times and studied its map.

Q. In what direction can the City of Newark be increased in size without absorbing part of the territory of the Passaic Valley Sewerage District?

2646 A. The City of Newark can grow to the south very extensively. It is planning to do that very thing now by the construction of a new harbor and terminal facilities.

Q. Do not you know that that territory is in fact included in the City of Newark now?

A. Yes, but not in the Passaic Valley District, as I understand it.

Q. You do understand it?

A. I so understand it; yes, sir. The south line of the City of Newark is at present south of the location of the pumping station or terminal point of the Passaic Valley Trunk Sewer, and, of course, some territory might be added to the south by a deep sewer running northerly, but my study of the subject was that the Passaic Valley did not include the meadows territory belonging to the City of Newark. Not much of it.

Q. That conclusion and study is based on the report of 1908?

A. Yes, and the maps.

Q. Do you not know what the present plans are, if they have been changed?

A. No, not in that respect.

Q. And immediately south of the City of Newark do you know that the City of Elizabeth is located adjoining the City of Newark?

A I think six or seven miles south.

Q. You think that?

A. There is a large area between Newark and Elizabeth, if I mistake not.

Q. You mean territory that has not been annexed?

A. Yes.

Q. You do not mean that it is included within the municipal boundaries of the city of Elizabeth?

A. I think there is another territory there that is in another township, separate township. I do not remember definitely, but in looking over those areas I am under the impression now that there was a stretch along the west line of Newark Bay of some miles between the boundary line of Elizabeth and the south boundary line of Newark. It was inscribed with the name of some township, and I do not remember it definitely.

Q. You do not want to be understood as going on record as
2647 saying that any such thing exists; you are simply giving your impression?

A. Yes, I do not want to make that as a statement from absolute knowledge. It is merely a recollection from studying a map.

Q. You would not want your memory or observation or veracity determined by the existence or non-existence of such a territory, would you?

A. No. I would not desire that.

Q. I can assure you that there is not any such town as that.

A. I used the map of the State Geological Survey.

Q. I have been a resident of that section all my life, and I assure you that there is no such territory.

A. I do not know definitely about it.

Q. Now, Mr. Kuichling, taking the territory of the City of Newark as it is now constituted by law, how much unsettled territory suitable for habitation is there within the City of Newark unoccupied?

A. I should say several square miles.

Q. And where is it located in your judgment?

A. Largely in the meadow district, south of the built up portion of Newark. There is also territory to the north, I believe.

Q. Within the limits of the city?

A. I think so, and to the west, that are not well built up.

Q. In your opinion will the territory unoccupied within a city limit suitable for habitation in any way serve to determine the growth of that city assuming that its territory is not increased by annexation?

A. Yes, it always does, in nearly every instance.

Q. That you may have in one decade a growth of 40 per cent.

and in the next 30, and if there is no other territory to be annexed the rate may fall very much below those figures?

A. Yes, it may fall somewhat under. And I want to express that in this way, by saying that so far as I know from studies of the populations of hundreds of cities of this and other countries, I know of none in which a rate of growth of 1½ per cent. per year has prevailed for any such period as 10 years.

Q. Well, don't you know, Mr. Kuichling, that the territory adjacent to the city of Newark, suitable for habitation, lies largely
2648 within a territory outside of the Passaic Valley Sewerage District?

A. I should say I do not know that, because the possibilities of sewerage are almost unlimited. One can, by tunneling and other deep excavations, one can sewer districts that are in entirely different topographical watersheds.

Q. You understand that the Passaic Valley Sewerage District is a district defined by metes and bounds by the act creating it?

A. Yes.

Q. Then I ask you what relation the question of tunneling has to do with the question of where the available territory is located which is suitable for residences adjacent to the City of Newark and unoccupied?

A. (No answer.)

Adjourned to June 28, 1912, at 10.30 A. M.

Supreme Court of the United States, October Term, 1911.

THE PEOPLE OF THE STATE OF NEW YORK, Complainants,
against
STATE OF NEW JERSEY and PASSAIC VALLEY SEWERAGE COMMISSIONERS, Defendants.

Before James D. Maher, Esq., Commissioner.

CORPORATION COUNSEL'S OFFICE,
NEW YORK, June 28, 1912—10.30 o'clock a. m.

2649 Appearances:

Dr. William J. O'Sullivan, Special Counsel for the People of the State of New York, Complainants.

Adrian Riker, Esq., of Counsel for the Passaic Valley Sewerage Commissioners, Defendants.

Met pursuant to adjournment.

EMIL KUICHLING, called on behalf of Complainants, recalled for further examination, testified as follows:

Cross-examination by Mr. Riker (continued):

Q. I think you had some difficulty with the question because of the obscurity of the question?

A. The last question, yes.

(Question repeated by the stenographer.)

A. There is no necessity for tunneling in that portion of the city of Newark which is at present unoccupied, unless it be found cheaper than to make excavations for large sewers in open trench through wet soil.

Q. Well, you refer now to the low land lying along the bay?

A. Yes, sir.

Q. You include those, do you, in the property that is in your opinion suitable for residences?

A. That can be made suitable for residences.

Q. Do you happen to know at what rate the Newark Meadows have been appropriated for residences during that last ten years?

A. I judge from some photographs that I have seen that they have not been extensively used for residential purposes.

Q. What purposes, in your observation of them, irrespective of your photographs, have they been adapted for?

A. Thus far there have been only one or two small farms that I have noticed in the vicinity of Newark, little knolls in this swamp. Otherwise it is a great expanse of rushes, sedges.

Q. Tidal swamp land, is it not?

A. Tidal meadows, I believe they call it.

Q. And so far as you know there is no extensive reclama-
2650 tion of these meadows for residential purposes which has occurred within the last 10 years?

A. I think not, sir. I know simply there has been a project to reclaim these meadows for a good many years back.

Q. Do you happen to remember as far back as the Driggs Drainage Canal scheme?

A. I do not recognize that.

Q. You could not go back a matter of 40 years in your recollection?

A. Yes, I remember I should say something like thirty years ago there was a discussion of the subject and after 1890 Mr. Vermeule wrote several articles. I think they appeared in the New Jersey Geological Survey reports, providing for the reclamation of those meadows.

Q. Now, assuming there is no additional territory available for additions to the city of Newark except from that territory which is included within the Passaic Valley Sewerage District, from your knowledge of the territory which is included within that district is it your opinion that the increase in population that has been estimated by the commissioners or their engineers is too low?

A. Yes, sir.

Q. Why?

A. Because the average density of population upon the given area is lower than one would expect thirty years hence.

Q. How much lower?

A. I should more than double it, the percentage they have allowed.

Q. Without calculating on any increase by annexation of territory?

A. Yes, without counting upon that. The density of population that I have estimated is fifty per acre, about fifty per acre, and that gives 800,000 people in the year 1940.

Q. Within what?

A. An area of 23 or 24 square miles, 23.7 square miles.

Q. What is that area?

A. The area of the city of Newark.

Q. Including the whole of the city of Newark?

A. Yes sir.

Q. Why do you include that part which is not within the district; you know there is a part not within the Passaic Valley Sewerage District?

A. I think a square mile or so, according to the reports.

Q. Where is the square mile?

A. It is a little over 2 square miles.

2651 Q. Where are they located?

A. I believe that territory is in the annexed district which was formerly called Clinton.

Q. That is only your belief, is it not?

A. Yes.

Q. You do not want to go on record as stating it positively?

A. No, sir, that is my recollection of it in looking over the map of the sewer system of Newark. It was a portion that was marked, I think, as Clinton. It was draining southerly into another outlet sewer, and I believe that is the area that is not included in the Passaic Valley District.

Q. Supposing I refresh your memory by asking you whether what was formerly the borough of Vailsburg is not part of the city of Newark, and if it does not discharge through what is known as the joint sewer?

A. Vailsburg was annexed to Newark, according to the United States Census report, Vailsburg Borough, was annexed in 1905, and part of Clinton township in 1902.

Q. Well, then, Vailsburg was annexed in 1905, and do you or do you not know whether that drains through the joint sewer as distinguished from the Passaic Watershed?

A. I do not know that the whole of it does. I believe that a portion of the former Borough of Vailsburg goes southerly in what is known as the joint outlet.

Q. Having been counsel for the construction of that sewer, will you take my word for it that it discharges into the joint sewer?

A. Certainly.

Q. And don't you know that a considerable section of the city of Newark, as it existed before the annexation of Vailsburg, being the westerly slope, also drains through the joint sewer outlet?

A. No, sir, I do not.

Q. Will you take my word for it that it does?

A. Yes sir.

Q. And you have never calculated the area included in these two districts, have you?

A. No, sir.

Q. That section of the meadows which lies along Bound Creek, being the dividing line between Essex and Union counties and the cities of Newark and Elizabeth also, do you understand that this is included within this sewer project?

A. Yes, I understand that all that is north of Bound Creek is included in this project.

Q. Will the territory which we have now been referring to, if excluded from your calculations of increase of population of the city of Newark, have any perceptible effect on your result?

2652

A. Yes, it would have a perceptible result.

Q. Well, in your investigations of this subject from a scientific point of view would you not think it worth while to get accurate information in regard to those features of your problem?

A. Yes, I think it would be desirable to have all the accurate information that is now available.

Q. Why did not you get it?

A. I tried to get it from the officials in charge, the engineering officials in charge.

Q. You mean you tried to get the area of the city of Newark and could not get it?

A. No, I could get that.

Q. And the area within the Passaic Valley Sewerage District, could not you get that?

—. I got that from the report of 1908, as to the prospective development of these Newark Meadows, there was little to be said on that subject by the officers in charge of the city of Newark.

Q. And in your testimony you have undertaken to criticise, have you not, the results of the estimates of the Passaic Valley Sewerage Commissioners and their engineers as being unreliable?

A. Yes, sir.

Q. You think your own results are entirely free from criticism on that basis?

A. I do not believe that they are absolutely free from criticism. They simply represent my judgment as to what will happen in the year 1940.

Q. As opposed to the judgment of the commissioners and their engineers?

A. Yes, sir.

Q. Do you know who their engineers were?

A. Edlow Harrison.

Q. Who else?

A. Previously it was Messrs. Hering and Fuller.

Q. Anybody else that you know of?

A. Further back, in the late 90's, Doctor Ftelly and Mr. Jacobson.

Q. Do you know whether Mr. Allan Hazen had anything to do with it?

A. I know that he has had to do with the sewage of Paterson.

Q. Not with the whole plan?

A. Not that I am aware of, sir.

Q. And Mr. Whipple?

A. He was a partner of Mr. Hazen's and I believe the report was issued by them.

2653 Q. Now, some of your direct testimony has been devoted to considerations of the ground water infiltration?

A. Yes.

Q. You have gone into that to some considerable extent?

A. Yes, sir; I have studied that subject very carefully for thirty or forty years.

Q. What construction of main outlet sewer are you basing your calculations on in your testimony on that?

A. I should consider concrete or brick.

Q. No difference as to infiltration?

A. No, I should not consider that there was any material difference between those two materials in construction. I am, of course, assuming that the brick be laid in cement mortar and properly laid.

Q. Do you give any figures on infiltration in that construction?

A. I think I gave some in my direct testimony. If not, I can give some others.

Q. Do you think that that construction is as watertight as concrete?

A. Yes, it is on the whole, from my own experience, it is safer and better than concrete.

Q. You mean safer as to infiltration?

A. Yes, sir.

Q. You did not mean it in any other connection?

A. No, simply in relation to infiltration.

Q. When you state from recollection the amount of ground water from infiltration in a concrete sewer of definite dimensions; I ask you whether you can state from recollection?

A. No, sir.

Q. You cannot do it without turning to your data?

A. No, I do not try to carry those figures in my head.

Q. Is it any considerable percentage of the capacity of such sewers?

A. Yes, generally.

Q. Well, what are the exceptions?

A. It will depend upon the grade.

Q. What has the grade got to do with infiltration?

A. The grade has to do with the capacity.

Q. It has nothing to do with the gross amount of infiltration, has it?

A. The grade has nothing to do with the gross amount of

2654 infiltration, but the gross amount of infiltration has to do with the size of the sewer, and the size of the sewer is governed by its capacity and grade.

Q. Do you know what the grade of the proposed sewer of the Passaic Valley Sewerage Commissioners is?

A. Yes, I have a list of the grades as taken from their report; the report of the commissioners of the Passaic Valley Sewerage District for 1908, commencing at Paterson and ending at the Newark Meadows.

Q. Now, take the grades in the city of Paterson, have you got them?

A. Not all the sewers of the city of Paterson. Of the trunk sewer?

Q. Yes.

A. Yes, I have those for the trunk sewer in the city of Paterson. The first section is 2,120 feet long, 4 feet in diameter, and has a grade of .62 feet in a thousand feet.

Q. What is that section, is there any other way of distinguishing it?

A. It runs from Prospect street to Bridge street. The next section from Bridge street to Montgomery street is 1,150 feet long and 4 feet in diameter, and has a grade of .52 of a foot, per thousand feet. From Montgomery street on to Hope avenue the grades are about the same.

Q. What is that?

A. From .53 of a foot to .54 feet and then further down the grade reduces to about .38 foot per thousand feet for a long distance. That brings it to the pumping station at Newark.

Q. Well, now take a 13-foot sewer at the grade you have defined in the last section to the pumping station, what is the percentage, if you can state it, of infiltration of ground water in a concrete sewer of those dimensions?

A. I cannot give it in a percentage direct. I can say it would be at a certain rate per square foot of surface, on the average per mile.

Q. You have not figured it out then for the dimensions indicated?

A. No, sir.

Q. Have not you given in your direct testimony an estimate of the ground water infiltration in this particular sewer in gallons?

A. Yes, taking the whole territory, what will reach this sewer, not only itself, but from tributary sewers. There will be hun-
2655 dreds of miles of those in the year 1940.

Q. And I suppose the ground water infiltration in those depend very largely on the method of construction and laying of the sewer?

A. Yes, sir.

Q. What are you assuming in regard to that in your figures for 1940, as to construction?

A. I have assumed that the construction will be what is prevalent at the present time, and has been prevalent for the last fifty years.

Q. In this district?

A. Anywhere in the best sewered cities of the world.

Q. Well, you have had some figures on this particular district, have you not?

A. Yes.

Q. Have you not estimated the additional sewers upon the basis of those that were in this district?

A. Not on the basis of those. If I had taken it on the basis, what was reported for the sewers in the Orange district and in the joint outlet area, I would have had a much larger figure for infiltration than I have adopted.

Q. Do you happen to know the construction of the joint sewer, what it is?

A. I do not remember definitely whether it would be brick or concrete.

Q. Do you know, as a matter of fact, it is tile pipe construction, without any special precaution as to joints. Don't you know that?

A. No, I do not.

Q. Did not you investigate that feature of the sewer?

A. No, sir.

Q. And still you base some of your calculations on that?

A. I base my calculations on the figures I have given in my direct testimony as to the sizes of those sewers and their character.

Q. Of what value is a comparison between an open joint tile sewer and a compact sewer, so far as ground water infiltration is concerned?

A. A great deal of value for this reason, that if the ground water is troublesome every individual property owner will get rid of it and discharge this water into the sewers, if he can, and if the sewer is built absolutely watertight and if it were made of cast iron
2656 pipe with lead joints for water under pressure, the individuals would get rid of the water by laying individual lengths of small open jointed drain tile which will discharge into the sewers. It is therefore of very little consequence, so far as the ground water is concerned, whether the sewer be very tight and impervious or not. If the ground water is troublesome, it will find its way directly or indirectly into the main sewer.

Q. And whether the sewer joints are tight or not, a sewer laid in a public street the infiltration, in your judgment, will be the same because of the surreptitious action on the part of the property owners, is that what you mean?

A. I do not mean exactly that.

Q. What do you mean?

A. I mean exactly what I said. These actions of the property owners are not surreptitious necessarily. They are simply natural means of getting rid of what to them is a natural nuisance.

Q. And the amount of discharge through the sewers in the way of ground water is not affected in any way as to the actual construction or laying of the main lines, lateral lines, of the sewers in the public streets?

A. Yes, to some extent it is affected by it. If it were a large sewer 13 feet in diameter, 20 feet below the surface of the Passaic River, done with open joints, I should expect very much more infiltration than I have estimated.

Q. I recall from your testimony that you disagreed in the estimate of the commissioners as to the amount of ground water infiltration in the proposed outlet sewer?

A. Yes, sir.

Q. Is ground water a polluting element in sewage?

A. Sometimes it is, sometimes not.

Q. When is it?

A. When it contains acids in solution, or when it contains much organic matter.

Q. In the territory in question, the Passaic Valley District, is there anything within your knowledge which would indicate that the ground water infiltration will be a polluting element in the
2657 sewage discharged into New York Bay by that sewer?

A. No, I have no direct knowledge of any polluting substances coming in from the ground water.

Q. And in so far as it reaches the sewer outlet in question in larger quantities than those estimated by the Passaic Valley Sewerage Commissioners, it is a diluting agent rather than a polluting agent, is it not?

A. It is a diluting agent so far as it goes, but indirectly it becomes a polluting agent by occupying capacity in the trunk sewer which is desired for real sewage and polluting matter.

Q. You think it serves to assist in the pollution of the discharge proposed at Robbins Reef in New York Bay?

A. No, but it would serve to increase the discharge of sewage by the overflows into the Passaic River, and in that way create an undesirable condition in the Passaic River.

Q. And not in New York Bay?

A. No, sir.

Q. Some part of your testimony, as I recall it, is directed to the failure of the commissioners to provide for storm water?

A. Yes, sir.

Q. Is this storm water, which has been excluded in the estimates of the commissioners, a diluting or polluting agent, in your opinion, in the discharge at Robbins Reef?

A. The first runnings of storm water will be far more polluting than the later runnings.

Q. Well, it is those first runnings, it is that very overflow of the first flushings of the sewer, that you are complaining are not provided for in this plant, is it not?

A. Yes, sir.

Q. And those are to be discharged into the Passaic River instead of through the sewer?

A. I so understand it.

Q. The results of that will be what on the effluent at Robbins Reef, it will be a benefit so far as the intensity of the pollution is concerned, will it not?

A. It will not affect the discharge of sewage at Robbins Reef, but it will affect the pollution of Newark Bay, and thence through the Kill van Kull the Upper New York Bay.

Q. It will not affect the waters at Robbins Reef, but it will affect the waters of the Passaic River; how do you account for that?
2658 A. The storm overflows that are provided for all of the tributary trunk sewers to the main branch sewers will discharge into the Passaic River and pollute that. There will probably be some discharge of the Newark sewers at the very head of Newark Bay. We will then have a severe pollution of all the waters of New-

ark Bay, and this will necessarily affect the character of the effluent of Newark Bay into upper New York Bay.

Q. So that it makes no difference, in your opinion, whether the sewage is discharged into Newark Bay or New York Bay, so far as the pollution of New York Bay is concerned?

A. Are you speaking now of sewage proper, or storm water including sewage. Sometimes the word storm water includes sewage?

Q. I am trying to speak of what you were speaking of?

A. I was speaking of the storm water.

Q. Very well.

A. It makes a difference in New York Bay whether the storm water be carried to Robbins Reef or whether it be discharged into the Passaic River and Newark Bay.

Q. Will it be beneficial or injurious to have it discharged into Newark Bay rather than at Robbins Reef?

A. It will be beneficial to Upper New York Bay rather than beneficial to Newark Bay. It will pollute Newark Bay, and Newark Bay will then act as a sedimenting basin, so that the effluent therefrom into New York Bay will be of better quality than the original storm water.

Q. And to that extent it will be a benefit to the waters of New York Bay to have the provision as to storm water excluded from the Passaic Valley sewer?

A. Yes.

Q. Now, in your calculations of capacities of the proposed Passaic Valley Sewer, you have taken as a basis of your estimates the probable population of the district in 1940?

A. Yes, sir to some extent.

Q. And you have estimated a sewer of a capacity or size stated in your testimony which in your judgment will be necessary to accomplish the results?

A. Yes, sir.

2659 Q. Is that 18 feet in diameter, that sewer—cannot you give that without referring to your notes?

A. I do not remember whether this embraced all that you have stated in your question. 18 feet would be the diameter of the last section of that sewer under the conditions stated in my testimony.

Q. Do not you know that the sewer that is proposed to be built has been contracted for?

A. No, sir.

Q. Between the municipalities in the Passaic Valley and the Sewerage Commissioners?

A. No, sir.

Q. Have you endeavored to keep yourself acquainted with the conditions in this district as to which you were about to testify?

A. In a general way I have.

Q. Now, assuming that a sewer of the size of 13 feet in diameter is the sewer that is proposed to be built, what relation has your estimate of future population to do with that sewer?

A. My estimates would indicate that the sewer is not of sufficient size to accomplish the purpose aimed at.

Q. In other words, it is a criticism of the plans of the commissioners, so far as the communities are concerned, and not so far as the waters of the Upper Bay are concerned?

A. That is right.

Q. What do you understand is the issue in this litigation in which you are called to testify?

A. The pollution of Upper New York Bay by the sewage of the Passaic Valley Sewerage District.

Q. Not the question as to whether or not the plans of the commissioners are correct or faulty?

A. Indirectly that would have to do with the matter in my opinion.

Q. In what respect in your opinion has that to do with the pollution of the waters of New York Bay by the proposed sewer?

A. It would have to do with it in respect to the quantity of sewage to be carried by this proposed sewer to the proposed point of discharge.

2660 Q. The expected pollution of the waters of New York Bay would be determined by the capacity of the proposed sewer, would it not?

A. By that and a duplicate sewer in the future.

Q. Are you calculating among the possibilities in this case upon a duplicate sewer?

A. I am not calculating upon that.

Q. Well, what *has* your exaggerated estimates of population of 1940 got to do with the sewer proposed?

A. First, I would answer that, that I do not believe my estimates are exaggerated. I take exception to the phrase. Now then, my estimates of population have nothing particular to do with the capacity of the sewer as proposed, but in the plans for this outlet there is provision for an additonal outlet, indicating to me clearly that there is in contemplation the removal of the sewage from the whole of that territory, irrespective and independent of the size of the sewer now contemplated for construction.

Q. Do you understand there is any other sewer contemplated than the one described in the report of 1908?

A. Not for the main part of the trunk sewer above the pumping station, but there is provision in the plan for increasing the outlet at Robbins Reef.

Q. Where is that provision; is it in the contract that these municipalities have entered into?

A. I do not know what the contract is that they have made. I do not know what it has been.

Q. Don't you think it is a little rash to testify as to proposed things, without knowing what the contract is?

A. Which contract?

Q. Between the municipalities and the Passaic Valley Sewerage Commissioners for the construction of an outlet sewer?

A. I do not know the provisions of those contracts. I only know that on the plans of the outlet at Robbins Reef there is provision for an additional line and system of distributing pipes.

Q. You know it is proposed for a number of double outlets to be built; I suppose there is no physical objection, so far as you know?

A. Yes.

Q. Why do you limit yourself to two?

2661 A. They have simply shown two. They have shown one system to be built, another one in dotted lines to be constructed some time in the future. There is no reason why they should not construct two or three or a dozen more in the future, but I have stated in my testimony that the plans show a provision for another system of outlet pipes, that is all I have said.

Q. And you are now willing to say that in your opinion such a system is now contemplated, are you?

A. I would make that inference from the fact that there is an indication of such a thing upon the plans.

Q. Now, you have devoted a good deal of testimony to the discussion of trade wastes. Where do you anticipate the trade wastes to come from?

A. The trade wastes will come from the factories and industries in the various communities served by this proposed outlet sewer.

Q. Which ones in particular have you in mind as likely to contribute to the trade wastes?

A. The Paterson silk mills, the woolen mills at Passaic, the various breweries, the chemical works in the valley, and the multitude of industries in the city of Newark.

Q. Now, quantity for quantity is the trade waste from the silk mills in Paterson more injurious and polluted than domestic sewage?

A. Volume for volume there is less in the effluent from the silk mills, the aggregate effluents from the silk mills, than there is in ordinary domestic sewage, but there are portions of the effluents from the silk mills which contain as much if not more matter that is putrescible than is contained in domestic sewage.

Q. Volume for volume is the trade waste from the woolen mills of a higher degree of pollution than house sewage?

A. Some portions of the woolen mills where they scour the wool; cleaning the raw wool is worse, much worse than domestic sewage, volume for volume.

Q. On the average is the trade waste from the woolen mills at Passaic, in your opinion, of a higher degree of pollution than the average house sewage in the district that we are discussing?

A. I am not able to answer that question directly, because

2662 I have not a good knowledge of all the wastes that come from the Passaic Woolen Mills. I have seen some discharge that I should regard as worse than any domestic sewage, but this was only for a short time, and what it would be some hours later I could not say, nor have I been able to obtain the statistics that would be necessary to answer your question directly.

Q. You would not venture an opinion on that?

A. No, sir, not for the whole. I do not know what the character of all the wastes is.

Q. Is trade wastes from a brewery, volume for volume, more putrescible than the average for the house sewage in the district, in your opinion?

A. Some portions are more putrescible, volume for volume. On the average, taking all of the water used by a brewery and discharged is probably somewhat less offensive and putrescible than domestic sewage.

Q. In brewery wastes, is the putrescible matter animal or vegetable in character?

A. It is vegetable, but the putrescible portion of it I mean is substantially the same in chemical composition as the animal matter, as there is no distinction chemically between vegetable albumen and animal albumen.

Q. Is there any difference as to pathogenic germs?

A. There are no pathogenic germs in some of the brewery waste.

Q. Then there is a difference in that respect?

A. There is a difference in pathogenic germs, yes.

Q. You have testified that you have given some attention to the proposed sewer of the Passaic Valley Sewerage Commissioners, have you?

A. Yes, sir.

Q. Don't you know that the capacity in the sewer is apportioned to the different municipalities on a basis of percentage of the capacity?

A. I do not know that it is so proportioned. I assumed that it would be proportioned in some such way.

Q. Is it not stated that that is the plan in the report of 1908?

A. I do not remember definitely.

Q. Now, assuming that to the city of Paterson there is ap-
2663 portioned a capacity of 21 per cent. of the whole capacity of the sewer, and that the sewer is defined by size and its capacity is indicated by its grades, in your opinion does it make any difference whether the trade wastes are discharged up to the 21 per cent. capacity or house sewage is discharged up to the 21 per cent. capacity so far as the waters of New York Bay are concerned?

A. No, I presume it would not make very much difference.

Q. Then, beyond the intensive criticism of the accuracy and ability of the commissioners and their engineers, what in your judgmnt is the value of your testimony as to trade wastes in this case?

A. I should say that my testimony should have considerable value a in this case.

Q. In what respect, what bearing has it on the issue?

A. Inasmuch as the Passaic Valley Sewerage Commission plan does not provide for the interception and treatment of trade wastes that will probably be found in the year 1940.

Q. What has that got to do with the State of New York and the proposed discharge at Robbins Reef?

A. Well, I should say it has considerable to do with it.

Q. If the trade wastes to which you have testified have no different polluting power on the average than house sewage, what difference does it make whether house sewage or trade wastes are discharged in a definite amount, limited by the size of a sewer and its grades, in the harbor of New York, so far as the waters of the harbor are concerned?

A. It will depend upon the character of those trade wastes very materially. If some of those trade wastes be strongly acid, the effect upon the digestive capacity of the Upper Bay will be a very marked one. Will impair it greatly, will kill many of the organisms upon which this digestive capacity rests. If, on the other hand, some of those trade wastes be poisonous to those organisms, they will retard the natural processes of so-called self-purification of water and there will be a very marked effect.

2664 Q. Now, what are those trade wastes in the district that you refer to, if you know?

A. There are the fats, resins, and oils coming from the silk mills at Paterson. The fats coming from the woolen mills, various acids from the chemical works, and from the metal works; various products that are dangerous to fish life and the smaller life in the water, coming from breweries and distilleries. There are a variety of other industries that might be mentioned. If there were any beet sugar works,—I do not know if there are any.

Q. I asked you what are in the district, not what might be?

A. All that must however be taken into consideration in dealing with the future.

Q. Are these acid producing works, factories, confined to this district, or do they have some in New York City?

A. I think there are some in New York, in Greater New York. I do not know of any in the city of New York, that is, the Borough of Manhattan.

Q. Are there any such establishments in Brooklyn?

A. I believe there are.

Q. In the Borough of Queens?

A. I do not know of any in Queens.

Q. Where is Hunter's Point?

A. I thought Hunter's Point was in Brooklyn.

Q. I do not know; I am asking you.

A. I can tell you in a moment. I think Hunter's Point is included in Brooklyn Borough.

(Witness examines map.)

A. My maps do not reach it.

Q. Hunter's Point is in the greater City of New York, however?

A. I believe it is.

Q. You know it, don't you?

A. Yes, sir.

Q. And all the establishments in Greater New York, so far as you know, are disch-rging their sewage into the Bay of New York or the East River or the Hudson River?

A. They discharge mainly into the rivers, and not directly into the bay. A few of the number discharge directly into the bay.

Q. The acids reduce in intensity as they are diluted, do they not?

A. Generally, but not always. The diluted acid may be in
2665 some respects more active than a concentrated acid.

Q. Now, the acids in the nature of trade wastes, which

you have testified to as likely a to be dangerous to fish life, have you made any comparison in the amount of such acid produced and discharged as trade wastes in the Greater City of New York and the Passaic Valley District?

A. No, I have not made a computation.

Q. Then, so far as this case is concerned, the criticism of the plans of the Passaic Valley Sewerage Commissioners, made by you in your testimony as to ground water infiltration, and as to the absence of provision for storm water, are beneficial rather than the contrary to the character of the proposed discharge into New York Bay?

A. Yes, on the whole, somewhat beneficial.

Q. And all your criticisms are in fact directed to is the skill and ability of the engineers and the Passaic Valley Sewerage Commissioners in providing for that?

A. I am not willing to say that. I do not wish to reflect at all on the skill or ability of the engineers. I simply set up my judgment in opposition to theirs and give it simply for what it is worth.

Q. If you had been called upon to deal with the problem, however, as an engineer, you would have made different plans?

A. I believe I would have made a larger sewer and would have made provisions for the interception of storm water, at least the first runnings.

Q. And your criticisms go to the extent, do they not, of stating that in your judgment the capacity of the sewer in a great many respects is inadequate for the work proposed to be done by it?

A. Yes.

Q. You do not consider that reflects on the skill of the gentlemen who have done it?

A. No, sir.

Q. Do you know who made these plans?

A. I think the first plans submitted in the report of 1908 were prepared by Messrs. Hering and Fuller.

Q. I think you said you did not know whether they had in fact been approved by Messrs. Hazen and Whipple?

2666 A. No, I do not. A new set of plans has been made by Mr. Edlow Harrison.

Q. You know that?

A. Yes, I have seen some of those plans.

Q. And those, in your judgemnt, are also inadequate for the work proposed to be done by them?

A. In my opinion the sewer is not large enough. It will all depend, Mr. Riker, upon the degree of pollution of the Passaic River and Newark Bay that is contemplated. In my estimates I have considered it expedient to relieve the Passaic River and Newark Bay of this pollution that would come from storm water, as well as sewage, and have therefore assumed that the trunk sewer should provide for its removal, that is the first runnings of the sewer, and the amount that I have taken is very small.

Q. And you have been retained to testify in this suit, have you not?

A. I stated I did not know I had been retained to testify. I have simply been retained to prepare material for the use of the other witnesses, and present them to these man for guidance. I did not know until recently that I was to go on the witness stand at all, sir.

Q. You knew, however, that you were retained in the interest of the complainants in the pending suit?

A. Yes, sir.

Q. And your investigations were made with that in view?

A. To some extent. My purpose was to find what I believed to be the truth in the case, irrespective of whether it would be in favor of the complainants or the defendants in the case. Counsel for the complainants will, I think, assure you to that effect. I think I wrote him in my early letters that I wanted to know what the truth was and would give evidence only on what I believed was true, irrespective of which side is affected.

Q. But, you understood that your retainer was in the suit, and not to advise the Passaic Valley Commissioners or the municipalities concerned in that project?

A. Yes, sir, and I have not undertaken to give them any advice.

Q. And what was the issue in that suit, as you understood it?

A. The issue in this suit is whether the Passaic Valley
2667 sewer shall discharge the sewage of the Passaic Valley District into Upper New York Bay at a point near Robbins Reef Light.

Q. Yes, and in determining that, was or was not one of the issues, as you understand it, whether that sewage so discharged would constitute a nuisance?

A. Yes, sir.

Q. Affecting the State of New York?

A. Yes, sir, as well as the State of New Jersey.

Q. What has the State of New Jersey to do with the litigation between the State of New York and the State of New Jersey, so far as its interests are concerned?

A. It would create a nuisance that would affect both New York and New Jersey.

Q. You understand this litigation is between two parties?

A. Yes.

Q. And the party seeking protection from the court that is, the State of New York?

A. Yes.

Q. And the expected nuisance complained of was the nuisance contemplated by the State of New Jersey and the Passaic Valley Sewerage Commissioners?

A. Yes.

Q. Now, in your judgment, is it material to that issue whether a less amount than should have been computed was in fact computed by the Passaic Valley Sewerage Commissioners to be discharged into New York Bay; what business had you with that?

A. Why, I had this much business with it, that if the amount proposed to be discharged was much less at a given time than I

would anticipate, then I would have a right to point that out. It was my business to point it out. I should say that that would be a legitimate function.

Q. It was your business to point out a possibility?

A. Yes, sir.

Q. And it occupied a great deal of your testimony to point out what you believed to be errors in computations by those charged by a sovereign state with the duty of performing that work?

Mr. O'Sullivan: I object to that question.

A. I considered it my business to point out what errors
2668 of judgment, not what errors of computation, but what errors of judgment occurred in this matter. Incidentally, if there were errors of computation that I discovered I should certainly consider it my business to point them out. I have not referred to errors of computation, but simply to errors of judgment heretofore. This matter, and what is in the future thirty years hence, is not a question of exact determination. It is a question essentially of judgment.

Q. Why did not you confine yourself to dealing with the proposed sewer, as it was described of the dimensions and the grades which you had before you, and not with conditions which you now understand you were dealing with, conditions which had no relation to that capacity?

A. I assumed that a certain end was to be accomplished by this project of the sewer of the Passaic Valley District, and that if the sewer that was projected was not found to be large enough the end would be accomplished by another sewer. Therefore, it was fair for me in my judgment to take the proposition as a while into account, irrespective of the size proposed.

Q. Are you familiar with the Passaic River?

A. Yes, sir; fairly familiar with it.

Q. In your opinion is it a laudable enterprise to endeavor to purify it?

A. I believe it is.

Q. Have you any doubt about it?

A. No, sir; I have no doubt about it at all. It is my belief.

Q. And have you any doubt that some physical means are necessary to do that purification; it will not do it itself, will it?

A. The Passaic River will not purify itself, as at present. It is overloaded with pollution, especially in the warm season when the quantity of water is low. In freshets of the Passaic River matters are different.

Q. Now, you have I think testified in your direct examination to considerations of the waters of New York Bay?

A. Yes, sir.

Q. And that consideration has extended to the rivers dis-
2669 charging into New York Bay?

A. Yes, sir.

Q. Where do you find the greatest pollution at the present time, in New York Bay or the Hudson or the East River?

A. The greatest pollution is at the mouths of the sewers that discharge into these waters. If you speak of the waters as a whole the greatest pollution appears to the eye in the Harlem River.

Q. That is entirely within the greater City of New York, is it not?

A. Yes, sir.

Q. And the East River, how does that compare with the Hudson River and the Upper Bay, as you have observed it?

A. I think that the East River is in about the same condition with respect to pollution between Blackwell's Island and the Battery or Governors Island as the Hudson River from the Battery up to a point opposite Blackwells Island. That is, on the same parallel of latitude.

Q. The East River is entirely within the State of New York?

A. Yes, this portion of it.

Q. And the pollution, the polluting matter that has affected it, where does that come from, in your opinion?

A. It comes from the territory riparian or adjacent to it.

Q. And in the State of New York or in the State of New Jersey?

A. I should say mainly in the State of New York. The pollution may come in part from the sewage of New Jersey that gets into the Hudson and Upper Bay and is then carried by tidal currents up the East River and in that way effects a mixture between the local sewage and this intruded sewage.

Q. In order to do that it would have to pass in part through the Upper Bay?

A. Yes.

Q. Will you venture an estimate of the percentage of the effect of the New Jersey sewage upon the condition of the waters of the East River?

A. No, I do not care to express an opinion on that. It will depend entirely upon the character of the matter. If it be oily matter, such as we see coming from the Kill van Kull at times, and
2670 blown across the bay, that would go directly into the East River without any modification, floating on the surface, but as for the odor it would depend entirely upon what the character of the sewage is.

Q. How far is the mouth of the Kill van Kull from the East River?

A. About four or five miles.

Q. You mean to say that oily matter you have seen coming out of the Kill van Kull has ever been carried by the winds into the East River?

A. I have not seen it go there myself. I have seen fields of it issuing from the Kill van Kull, and it is very easy for the wind to blow that, in conjunction with flood tide, into the East River, although I have not seen it done.

Q. You are willing to say that you are of the opinion that it is done ever?

A. Yes, I should say that it is done at times, although I have

not seen it. It is so extremely probable that I make the answer, as I have stated, that it is done at times.

Q. To what extent?

A. I cannot say the extent.

Q. Infinitesimal?

A. No, there may be oily matter to the extent of hundreds of gallons.

Q. There may be?

A. Yes.

Q. Are you willing to say that in your opinion there is or ever has been any transportation of oily matter from the mouth of the Kill van Kull into the East River?

A. I should say that it is liable to happen.

Q. In what direction does the water of the East River flow?

A. The flood with the ebb tide, is southerly, and with the flood tide northerly, in the generally northerly direction. The river is not straight, it has an angle.

Q. And when it is going in the direction that you term northerly where does it discharge?

A. I think it discharges at the same place that it enters. It remains in the river and flows back with the ebb tide and gets into the Upper New York Bay.

Q. Have you any float experiment which indicates that
2671 the water at the mouth of the Kill van Kull ever reaches the East River?

A. There are some experiments indicating a direction from Robbins Reef Light towards the East River; not, however, from the mouth of the Kill van Kull, but Robbins Reef Light is about one mile easterly of this mouth.

Q. The mouth of the Kill van Kull?

A. Yes, sir.

Q. Where is the proposed outfall of the Passaic Valley Sewerage Commissioners' sewer with reference to the line dividing the State of New York from the State of New Jersey, if you know?

A. I believe I stated that in my direct testimony, and scaled it from the map. I do not remember the exact decimals of a mile, but undoubtedly it is within a quarter of a mile of the State Line, northerly, northwesterly, and a little over a quarter of a mile northerly from the boundary line that runs east and west from about the middle of the Upper Bay to and through the Kill van Kull.

Q. Entirely within the State of New Jersey?

A. Yes sir.

Q. You have examined, have you, a chart or any chart indicating the limits of the two states in the waters of New York Bay?

A. Yes, sir.

Q. Well, in your opinion does the discharge of sewage from the Island of Manhattan and the Borough of Brooklyn and the Borough of Queens into the Hudson River contaminate the water within the limits of the State of New Jersey in the Bay of New York?

A. I would omit from that the Borough of Queens, yet I do not think Queens borough sewage would get in there. The sewage from

the other districts would affect the quality of the water in the Upper New York Bay lying within the boundary of New Jersey.

Q. How about the Borough of the Bronx sewage; has that an effect upon the waters of the State of New Jersey?

A. It might affect them to some extent. Much of that goes out through the Sound, through the Upper East River into Long Island Sound.

Q. Does any of the water from the East River discharge into Long Island Sound, in your opinion?

2672 A. Yes. The records show that floats and currents showed that there is a current setting in from the Sound into Throgg's Neck inlet narrows, into what is called the Upper East River, and that on the ebb there is a flow outward in that direction. So, there is an oscillation of the water there, whereas in the lowest East River the floats show that the water does not flow in a generally northerly direction beyond Blackwells Island or Hell Gate, but that the tidal oscillation is confined to that portion between Hell Gate and Governors Island. One such float stayed there, I believe, for four days or more.

Q. Now, as between the State of New Jersey and the State of New York, which is the greater polluting agency of the waters of the bay at the present time, in your opinion?

A. I believe that the territory within the State of New York is the greater polluting agent.

Q. Can you give any percentage or proportion as to that?

A. No, I cannot directly, except as it would be formed based on the populations which I have already given. I can give you that if you wish it.

Q. You have given populations on the New Jersey shore, as I remember?

A. Yes.

Q. Did you include in those populations such part of the territory as drains into Newark Bay and the Hackensack River?

A. I separated those from the areas and communities that drain directly into the Upper Bay.

Q. Did you exclude these communities or the populations of these communities, those parts that drain into the Hackensack River or Newark Bay?

A. I think I did; I do not remember definitely. In some cases a separation of population was not made, but the drainage areas are correctly given.

Q. Well, now, can you recall what the percentage is upon the basis of population, of the pollution of the waters of New York Bay by the State of New York and the State of New Jersey?

A. No, I cannot give it without considerable expenditure of time. If you wish I can find it for you.

Q. I do not want to put you to any trouble about the matter. I just wanted to know if you had that in mind, or had made

2673 any computation in that regard.

A. No, I have not. For the whole territory, including the Passaic Valley, the Hackensack Valley, that would be given easier,

but to separate that I do not think I have got the figures for that. I would have to make estimates for them.

Q. Now, take the waters of New York Bay, the upper end, as distinguished from the lower end, and the Hudson and East Rivers and the Kill van Kull, which state, in your opinion, contributes the greater amount of direct or indirect pollution to the waters of that body of water?

A. I believe the State of New York contributes more.

Q. A great deal more?

A. Yes, sir, a great deal more than the State of New Jersey.

Q. Many times as much?

A. Several times as much.

Q. As many as ten times as much?

A. I am not prepared to say that. I do not recall the population figures exactly.

Q. Did you not hear testimony on the part of one of the witnesses for the complainants to that effect?

A. No, sir. If I did I have forgotten it.

Q. You do not know whether that is correct or not?

A. No, sir.

Q. And is the pollution of the waters of that body of water from the State of New York, in your opinion, perceptible within the limits of the State of New Jersey?

A. Yes, I should say it was, although, of course, one cannot distinguish the sewage because it is all of the same color and is not labeled, but I should say the waters of the Upper New York Bay within the State of New Jersey are polluted by sewage coming from some source, and as the State of New York contributes a considerably larger proportion of sewage than the State of New Jersey, the inference is justified that some of the pollution comes from the State of New York.

Q. Why do you limit it to some?

A. I do not know how much.

Q. Are you willing to state any percentage?

A. No, sir.

Q. Would you be willing to say there is more from the State of New York than from the State of New Jersey?

2674 A. No, I would not want to say that, because I know that there is much sewage coming from Jersey City and Bayonne that is discharged directly into the Upper Bay, and the currents are such as to rather carry off the sewage coming from the State of New York than to carry it up to the territory in the State of New Jersey. There is a line of principal currents near the state line, and sewage from the State of New York will tend to cross that—it will have some difficulty in crossing that line while there were currents. At other times, at slack water, when the currents are slight or insignificant, then it is likely that some sewage will be blown on the surface across into the State of New Jersey.

Q. And do your oxygen determinations that you have had submitted to you uphold that?

A. No, they do not uphold that directly, because the oxygen deter-

minations simply show polluted water without indicating the source of pollution.

Q. But they show a marked difference of pollution on the New York side of the line as compared with the New Jersey side of the line?

A. I do not remember the figures exactly. While I have looked at them rather closely, I do not remember the figures definitely.

Q. What I am trying to come to is this: Does the sewage from the State of New York, discharged as it is into the waters and rivers tributary to the Upper Bay and into the bay itself, constitute a nuisance within the limits of the State of New Jersey?

A. No, I do not think so, not at the present time. I should say I have not yet seen evidences of strong nuisance on the New Jersey side of the state line as yet. That is in the Upper Bay.

Q. Have you seen strong signs of nuisance on the New York side of the line in the Upper Bay?

A. Yes, I have seen the evidences of nuisance, strong evidence of nuisance in Gowanus Canal, and in portions of the East River, the lower East River.

Q. Do you include that in the Upper Bay?

A. No, oh no.

Q. That was what I was asking about.

2675 A. Gowanus Bay is a part of the Upper New York Bay, and the canal is not, except as being a tributary, but I would say that in Gowanus Bay I have smelled offensive odors, and I assumed that they came from the Gowanus Canal, from the waters of Gowanus Canal that were being discharged at that time into the Upper Bay.

Q. With that exception in the Upper Bay on the New York side of the line, have you seen evidences of pollution amounting to a nuisance?

A. Yes, I have seen muddy shores and pollution along the shore such as would become a nuisance in the way of bathing and shell-fish culture.

Q. Well, do they exist on the Jersey side?

A. The same condition exists on the Jersey side.

Q. The same evidences of nuisance?

A. Yes, meaning by nuisance, in this case, not an odor necessarily, but a deposit of putrescible organic matter.

Q. It prevents the use of it for bathing?

A. Yes.

Q. And for shell-fish purposes?

A. Yes, sir.

Q. Has it any other injurious effect?

A. Well, it has this effect, in depleting the water of dissolved oxygen necessary for the maintenance of fish life, and also for the development of suitable plankton for self-purification purposes.

Q. Does the reduction of oxygen in itself, without reference to fish life or the disposal of sewage, constitute a nuisance, in your opinion?

A. Not necessarily a nuisance of the offensive odor class. It becomes a nuisance from the economical standpoint rather as interfering with the development of shell fish.

Q. At what point of exhaustion of dissolved oxygen in the water are shell-fish unable to live?

A. I do not know that that has been determined definitely by the observation of men who have made a study of the subject.

Q. When you refer to that as constituting a economic nuisance, the reduction of oxygen, you mean in some undefined degree?

A. Yes, sir.

Q. You do not know what the degree is?

2676 A. No, sir, depending on the amount of oxygen removed.

Q. And depending upon the amount required for the preservation of shell-fish life?

A. Yes, sir.

Q. Which amount you do not know?

A. It is known from observation that shell-fish when they are covered with mud of a putrescible character that the shell-fish die.

Q. I was not asking you about the putrescible nature of the deposits of muds; I was asking about the reduction of the free oxygen itself.

A. The putrescible mud in the bottom affects the amount of the dissolved oxygen in the water very materially.

Q. I am asking you about the effect in itself without reference to anything else. I want to know what the nuisance is that the reduction of oxygen creates in itself; what injurious effects has it in itself?

A. The injurious effect is as affecting the development of major fish life first, and second shell-fish life, and third the minute organisms in the water, called plankton.

Q. Now, what degree in reduction in dissolved oxygen is consistent with the maintenance of fish life, if you know?

A. From observations of my own I can say that when about one-third of the dissolved oxygen has been lost or absorbed in any way fish can still live. That is, two-thirds of saturation still allows fish to live. Others have put a higher limit, and some others a somewhat lower. My own observations were of limited extent. It was simply with a small house aquarium and with gold fish.

Q. Others have said that they could not fix any limit at all?

A. Yes.

Q. And all the experts in this case said that they did not know what the limit was?

A. Yes.

Q. Your experiments led you to believe that 66⅔ per cent. would be the limit?

A. It might have been 70. My method of determination, of course, was rather that of an inexperienced than an expert chemist.

Q. Now, the discharge of sewage directly and indirectly into the Upper Bay from the territory in the State of New York, does

2677 it or does it not, in your judgment, create a nuisance within the limits of the State of New Jersey?

A. It is impossible for me to answer the question otherwise than I have before. I cannot tell how much of an effect it produced in the State of New Jersey by the sewage of New York. I cannot give it quantitatively.

Q. I did not ask you to give it quantitatively. I asked you whether it did create a nuisance, in your opinion?

A. If sewage to any amount, any extent, finds its way across the state line from the State of New York, then it may make a nuisance within the State of New Jersey, but to what extent I cannot say.

Q. That is a very guarded answer. What is the number of the population discharging sewage from the State of New York indirectly or directly into the waters of the Upper Bay?

A. In 1910 the population in the State of New York discharging sewage directly into the Upper Bay, the East River, the Harlem River, or the lower portion of the Hudson River, was 4,541,000, in round numbers.

Q. The discharge of this sewage, is it crude or treated in the main?

A. Crude in the main.

Q. A very large percentage of it is crude?

A. I believe so.

Q. You think it doubtful, do you, that the discharge of crude sewage from that number of population fails to create a nuisance in the sense that you define a nuisance in the waters of the Upper Bay within the State of New Jersey?

A. No, I would not say that. I simply do not know to what extent such a nuisance may be created by the sewage.

Q. My recollection is that you testified that if the thing happened, upon the assumption that something else happened it might be so, a very guarded answer?

A. Yes, that last answer that I gave. If it crosses the state line it is liable to produce a nuisance.

Q. Now, can you tell me the population in 1910 within the Passaic Valley Sewerage District, included within the Passaic Valley Sewerage District, of the cities of Newark, Bellville, Nutley, Paterson, Passaic, Acquackononk, Garfield, Wellington, North Arlington, East Rutherford, Rutherford, Kearney, Harrison, East Newark and Union?

2678 A. I can give them separate.

Q. Suppose you do.

A. I have not added them before.

Q. Suppose you add them up; within the district of the Passaic Valley Sewerage District.

(Witness figures.)

A. 509,782 in the year 1910. The total of that same district is now 734,396.

Q. What is that?

A. The total of the district.

Q. What district?

A. The Passaic Valley Sewerage District.

Q. I did not ask you that. I asked you of those municipalities.

A. Yes.

Q. So far as they lie within the district?

A. Yes.

Q. Now, taking a sewage discharge from the municipalities which I have named, and whose population you have determined from the census of 1910, will you say that in your opinion the sewage discharged from that population at Robbins Reef, as proposed by the Passaic Valley Sewerage Commissioners, will create a nuisance in the State of New York?

A. I think it will.

Q. And you are uncertain in your own mind whether or not the sewage from the population, nine times as great, within the State of New York, discharging, as it does, into the tributary waters of the Upper Bay, creates a nuisance within the State of New Jersey. Is that what you wish to be understood as saying?

A. Yes, you are right in that statement.

Q. Now, why will the sewage from the municipalities which I have named, and whose population you have stated for 1910, if discharged as contemplated by the Passaic Valley Sewerage Commissioners at Robbins Reef, within the State of New Jersey, create, in your opinion, a nuisance within the State of New York?

A. For the reason that the discharge of sewage at Robbins Reef is into a principal tidal current which will carry some of the sewage thus discharged at Robbins Reef Light towards and against the shores of Staten Island, which is in the State of New York. Also because that sewage so discharged, as proposed, may become odorous
2679 and discernible by the sense of smell.

Q. Anything else?

A. Also because it may be carried north by flood currents into territory within the State of New York.

Q. With what result?

A. With the same result, that odors may be transported and that the water will be polluted.

Q. Anything else?

A. I think that covers all the ground.

Q. Now, in your direct testimony, if I remember it correctly, you gave some statements of results of currents, and in the way of carrying surface waters and their contents to the Bayonne shores. Do you remember that?

A. Yes, sir.

Q. Bayonne is in New Jersey?

A. Yes, sir.

Q. Do those currents carry any of the waters containing sewage of New York, in your judgment, to the Bayonne shores?

A. Yes, some of the sewage coming from the north shore of Staten Island would doubtless mix with that which comes from the north shore of the Kill van Kull in the State of New Jersey, and the mixture would take place which on flood current would tend to be carried into the shallow water adjacent to the city of Bayonne.

Q. Where is the shallow water chiefly within the limits of the Upper Bay?

A. The greater portion of it is within a line running from Constable Point or Hook to the head of the piers of the New Jersey Central Railroad in Jersey City opposite the Battery.

Q. Is that or is it not, for the most part, within the State of New Jersey?

A. That is all within the State of New Jersey.

Q. Is sewage pollution of shallow waters more objectionable than of deep waters?

A. Yes, on the whole.

Q. Particularly in tidal waters?

A. Not necessarily in tidal waters.

Q. Is not a greater amount of the bottom of the body of water exposed in the shallows than anywhere else on the ebb tide?

A. A larger amount of the bottom, yes, would be exposed, yes.

Q. In so far as it is polluted by sewage that is the most objectionable part, is it not?

A. Yes, when discharged into deep currents, however, it is
2680 a question of transportation, because the sewage, a good deal of it, floats on the top and moves with the current.

Q. Now, this discharge into the waters of the Upper Bay from the proposed trunk sewer of the Passaic Valley Sewerage Commissioners, will these deposits along the shore, in your opinion, be comparable with those along the shores of the bay within the State of New York, due to the discharge of sewage from the city of New York and the other municipalities discharging into those waters?

A. No, sir, for the reason that the discharge proposed by the Passaic Valley Sewerage Commissioners is to be treated to some extent before being discharged.

Q. So that this particular feature of the nuisance will hardly be perceptible at all, will it, in your judgment, as compared with such deposits emanating or originating within the State of New York?

A. I do not understand quite what this feature refers to.

Q. The polluting of the shores.

A. The pollution of the shores with solid matter would be less than may possibly come at times from the State of New York.

Q. You have examined those shores, have you not, Mr. Kuichling?

A. Yes, I have examined them.

Q. And you have seen pollution along the shores?

A. Yes, sir.

Q. And where in your judgment do they come from?

A. I should say that most of the pollution I saw came from localities near by.

Q. Within the State of New York?

A. Both in New York and New Jersey. I would say along the Bayonne shore and what was formerly called Communipaw, now included in Jersey City. I believe the pollution that I have seen there came directly from the adjacent territory and not from across the bay.

Q. I was not perhaps definite enough, although I think your discussion covered chiefly the pollution of the New York shores and not the New Jersey shores. You have observed on the New York shores of the bay polluting matter?

A. Yes, sir.

2681 Q. Plainly visible?

A. Yes, sir.

Q. And where did that come from, if you are able to determine, from what you saw?

A. I cannot say where it came from, but I would say that probably the larger part of it came from the territory adjacent to the Upper Bay on the New York side, though some undoubtedly comes from Jersey City, discharges into the Hudson River and goes with the current, and the winds have some effect on it. Some may come from Hoboken, further up on the Jersey shore.

Q. And in amount, what in your judgment is the comparison between the sewage discharged from localities on the New Jersey shore of the bay and those discharged into the East River, the Hudson River communities directly in the Bay of New York, within the State of New York?

A. Very much less.

Q. Do you think the discharge as proposed from the Passaic Valley Sewerage Commissioners' sewer will be appreciable on the shores of New York State?

A. Not to the extent of solid matter. To the extent of the dissolved matters and gases, I believe it will be appreciable.

Q. Now, will you say that as to gaseous matters that it will be perceptible; in what way will gaseous matters be perceptible?

A. I believe that the sewage coming from this long trunk sewer in the Passaic Valley District will become odorous, strongly odorous before it is discharged at the point of outfall at Robbins Reef Light.

Q. Why?

A. It will be a long time on the road.

Q. How long?

A. From Paterson, in dry weather, it may be fully sixteen hours and from Newark it may be from six to eight hours. That includes, of course, the detention of settling tanks.

Q. What percentage of the sewage are you calculating as coming the long distances that you have mentioned?

A. The sixteen hour sewage would come from Paterson, as now laid out. It may be, however, that an extension of sewers might go into Saddle River township in the future, and make the time of flow somewhat longer.

Q. Well, if you are making guesses, Mr. Kuichling, why
2682 don't you extend it up to Brighton or any other long distance?

A. There is no objection to extending it to Brighton, so far as the principle is concerned. You might take in the whole of the Passaic Valley.

Q. Are you basing your estimate of age on those possibilities?

A. I stated distinctly in my report I considered a time of sixteen hours ample to cause sewage to *cause the sewage* be putrescent.

Q. What are you guessing about the township of Saddle River for, what has that got to do with the question?

A. Because a portion of the township of Saddle River was to be included in this district, and Little Falls has now recently petitioned to come into the district.

Q. To whom have they petitioned?

A. I think to the Passaic Valley Sewerage Commission, or the Passaic Valley Sewerage Commission has sought the right from the legislature to sewer this additional portion of territory westerly of and adjacent to Paterson.

Q. Are you testifying to facts within your knowledge now?

A. I was both informed verbally and read in the public press that there was an extension of the Passaic Valley Sewerage District contemplated, but I do not know whether it has passed the legislature or has been incorporated in the district or not.

Q. Well, your estimate of sixteen hours is based upon what?

A. Upon the flow from the longest sewer in Paterson, the head of the sewerage district to the point of discharge at Robbins Reef Light.

Q. What is the average age of the sewage, if you have calculated it, as to when it will be discharged at Robbins Reef Light?

A. The average age?

Q. Yes.

A. Probably ten or twelve hours, ten hours.

Q. Is that based upon any calculations or is that a guess?

A. That is based upon calculations.

Q. What calculations?

A. Given in my testimony.

Q. Turn to it and let me see what your calculation is.

(Witness examines records.)

A. The computation is that it will require 8.8 hours for the sewage to flow from Paterson to the proposed pumping station, or the settling tanks. To this period of time required for transit from Pater-
2683 son must be added 2.83 hours for transit through the submerger tunnel and pipe, discharge pipe, from the pumping station to Robbins Reef, and also the period allowed for sedimentation. Taking this at 2 hours, we will then have 13.63 hours. Adding to that about 3 miles of sewers in the longest line of sewer in Paterson in the future. I am assuming now a condition in the year 1940, when Paterson will be larger in area than it is, and allowing for that flow a period of about 2 hours will make 16 hours. Now, for Newark, which is much nearer by, I would allow about 3 hours flow in dry weather for the sewage within the city itself. That is within the main tributary lines to 3 hours.

Q. That is an average, is it?

A. It is the longest line of sewer.

Q. Why do you take the longest line?

A. Because that is the line that is going to be the one that will be in the most fermenting condition.

Q. That will determine the character of the outfall, will it?

A. Yes, then will come, I think, what is called the infection.

At 1 P. M. adjourned for noon recess until 2 P. M.

CORPORATION COUNSEL'S OFFICE,
NEW YORK CITY, June 28, 1912—2 o'clock p. m.

EMIL KUICHLING, a witness called on behalf of Complainants, recalled for further examination, testified as follows:

Cross-examination by Mr. Riker (resumed):

Q. Mr. Kuichling, we were inquiring about the age of the sewage and your figures for the discharge at Robbins Reef of the proposed sewer, and I asked you if you had the figures on which you reached the average of about 8 hours, I think you said?

A. Yes, sir.

Q. You thought you had them in your direct examination?

A. Yes, the average I did not compute. I have made an estimate since. I have said the longest line would take about 16 hours
2684 and that Newark, at the other end of the line, would take probably 8 to 10 hours, 8 hours. That would make an average of something like 12 hours for the age of the sewage from the most distant point of production to the point of discharge.

Q. What in your judgment will be the age of the sewage from the city of Newark, as distinguished from any other part of the sewage when discharged at Robbins Reef?

A. About 8 hours.

Q. How do you figure 8 hours?

A. 3 hours from the pumping station to the point of discharge; about 2 hours in the tanks; 3 hours in the city itself.

Q. 3 hours the average in the city, in your judgment?

A. Not the average. It would be for the longest line of sewer.

Q. Why do you take the longest line, I am asking you for the age, the average age?

A. I cannot tell you what the average age is without knowing the details of the sewer system of the city. That I have not got.

Q. Then you are not attempting to give an average; you are giving the longest age?

A. I am giving the longest age for the two communities, Paterson and Newark.

Q. Are you making any allowance for the difference in capacity, in the amount of discharge, of these two communities?

A. No, no material difference there.

Q. Why do you not, in making your averages. Is not that a proper factor to take into consideration?

A. Yes, it would be a fair factor to take into consideration as one factor. The quality of the sewage, though, is another more important one for the sewage that comes from Paterson and the other more distant communities than Newark.

Q. What is the difference in that, if you determined it?

A. The putrescent or septic sewage has the property of quickly infecting the fresher sewage.

Q. What is the length of time from Paterson to Newark, from your figures?

A. From Paterson to Newark is about 9 hours, and add to that 2 hours for Paterson, would make 11 hours, about.

Q. From Paterson to Newark about 11 hours you say?

A. I think that is it. Yes, about 9 hours from Paterson to the pumping station.

2685 Q. Paterson to Newark how long?

A. May be a half hour or an hour less, depending upon which point in Newark you take. Newark is several miles long on the river, the line of the trunk sewer. I have used the term "the pumping station" which is at the foot of the present built up area of Newark.

Q. What proportions are contemplated in the amount of capacity of Paterson and Newark in the joint sewer, if you know?

A. I do not remember definitely, except as you state that it is to be 21 per cent. for Paterson.

Q. Did I say from Newark?

A. No.

Q. If I say 46.8 for Newark, would that correspond with what you understand it to be?

A. I have not any doubt but what you are stating it correctly from the standpoint of the Passaic Valley Sewerage Commission.

Q. Do you know whether or not in the actual contract that has been executed for the construction of this sewer by the various municipalities and the Passaic Valley Sewerage Commissioners those are the percentages named?

A. I do not know what the contract is, but if you state that that is the figure named I am ready to accept it without question.

Q. Now, assuming that those are the proportions, 21.056 and 46.812, would that make any difference in your judgment of the average age of the sewage when it is discharged at Robbins Reef?

A. Yes, it would make a difference.

Q. How much difference?

A. On that basis the average age of the sewage would be between 10 and 11 hours.

Q. Well, now, those two places account for about 70 per cent. of the total amount?

A. 68 per cent.

Q. Now, the other 32 per cent. Have you made any figures as to the average age of those based upon the capacities of discharge?

A. No, sir.

Q. Bellville township, do you know where that is located?

A. Yes, sir.

Q. Where is that?

A. That is north of Newark.

Q. Immediately adjoining it?

A. Immediately north of Newark and adjacent to it.

Q. The town of Kearney?

2686 A. Kearney is opposite Newark, on the opposite side of the river.

Q. The town of Harrison?

A. That is also opposite Newark, on the east side of the river.

Q. In your judgment will the amount of discharge from these districts increase or cut down the average age of the sewage when discharged at Robbins Reef?

A. That would tend to reduce the average age, but we have yet to consider Passaic, which would increase the average age.

Q. Well, having in mind all of those places, what do you think now is the fair average age of the sewage when discharged at Robbins Reef?

A. I should consider that it would be not less than 12 hours, the average age.

Q. You have fixed on 10 hours for Paterson and Newark?

A. Yes.

Q. And you increase that to 12 for what reason?

A. Because of the large population that is expected between Newark and Paterson.

Q. I am talking of the present conditions?

A. The present conditions, beg pardon. I thought you referred to the other.

Q. No, the present conditions.

A. Present conditions. I would then say an 11-hour average would be pretty nearly right.

Q. Are you familiar with the Bronx Valley Sewer?

A. No, I am not.

Q. Have you examined that?

A. No, I have not studied that very much.

Q. You do not know the length of it?

A. No, sir, I do not.

Q. You do not know the average age of the sewage discharged from that sewer?

A. No.

Q. You know the discharge is in a crude stage?

A. I understand the discharge has never yet taken place. The discharge has been enjoined.

Q. Do you understand that the discharge is now enjoined?

A. I so understand.

Q. Have you not heard that that matter has been determined in the courts?

A. No, sir. For the reason that I was asked some time ago whether I would take up the subject of this Bronx Valley Sewer and its treatment, but I did not have time to do so and so declined.

Q. Now, Mr. Kuichling, are you familiar with the con-
2687 ditions in Boston Harbor arising from the discharge of sewage there from the Metropolitan District?

A. Yes, I knew it about five years ago quite well. I saw it frequently, but have not seen the deep submerged outlet in operation. I was there when it was being constructed, but I know the other outlets quite well, Deer Island and Moon Island, but the Nutt Island and Peddocks Island I have not seen in operation. I have seen it from a distance but not nearby.

Q. You have not made a close inspection within five years of that territory?

A. I have made a close inspection for Moon Island and Deer Island, but none of the deep submerged outlets.

Q. When did you make those?

A. About two years ago.

Q. Was not the other one in operation?

A. Yes, it was in operation, but the time was too short for me. I could not say.

Q. Taking the Moon Island outlet, do you know the average age of the sewage discharged there?

A. Yes, it is something like sixteen hours, if I remember rightly. It is stored in a tank for twelve hours, during the whole of the flood tide, and then the time to reach the tanks from the territory, as I remember it, is something like six hours more. That would be about eighteen hours—six hours for the average time—you are speaking of the average now. It would be perhaps twelve to fourteen hours, or may be sixteen hours.

Q. How long is that sewer system to its extreme end of its contributing branches?

A. I do not remember definitely, somewhere in the vicinity of nine miles I think. That is the Moon Island District. It may be ten I do not remember.

Q. Is it discharged in a highly septic condition?

A. At times, in the hot weather, it is rather offensive in odors.

Q. Highly septic?

A. Yes, at times.

Q. Have you been there when it was being discharged in hot weather?

A. Yes, sir.

Q. Did you observe a very disagreeable odor from it?

A. Yes, I did.

2688 Q. Who was with you?

A. Mr. Fisher, city engineer of Rochester, and his assistant.

Q. No one else?

A. No one except the attendant in charge of the station.

Q. Was Mr. Brown with you, William M. Brown?

A. No, sir; he was not present.

Q. Did you hear the testimony of one of the witnesses in this case that he was there and observed this discharge, and did not notice any specially disagreeable odor from it?

A. I heard one witness state that at one time, that he did not find much odor from it.

Q. You do not know what time of year he testified he had been there?

A. I do not remember.

Q. The sewage that is discharged there on the average is older than that which is contemplated to be discharged at Robbins Reef?

A. Yes, I think it is.

Q. 50 per cent older?

A. No, because at Robbins Reef the sewage is 12 hours old on the average, and this is 16, it would not quite be 50 per cent.

Q. You think it is within 18 and nearer 16 hours, do you?
A. Yes, I should say it would be something like that.
Q. Well, now, the other discharge in the harbor of Boston that you observed, Deer Island?
A. Yes, Deer Island.
Q. How old is the sewage discharged at that point on the average?
A. I should assume that was something like seven or eight hours' old.
Q. How long is that sewer?
A. I think it is something like eighteen miles long.
Q. How long is the Passaic Valley Sewer contemplated to be?
A. 26.23 miles long, from High Falls in Paterson, or the head of the trunk sewer, to the outlet at Robbins Reef.
Q. I do not, sir, remember what you said was the age of the sewage at the Deer Island outlet?
A. The average age I think is something like seven or eight hours; between seven and eight hours, from the extreme
2689 point or head of the sewer the age would obviously be longer.
Q. Well, that sewage as you observed it is discharged in a highly septic condition?
A. It was not in a highly septic condition at the time that I saw it.
Q. What season of the year?
A. It was in the summer, in July and August, and we got there between 9 and 10 in the morning. At that time the night flow, or rather the very dilute sewage from the upper portion of the territory was coming along and mixing with the thicker sewage from the lower part, which was then in comparatively fresh condition, so that the odor was not very perceptible. Later in the day I should fancy that it would be stronger.
Q. Well, the upper sewage is the older part of the mixture, is it not?
A. Yes, but the character of it varies in the different parts of the day. At night, from a residential district, the water as it comes is not highly charged with offensie matters.
Q. But it had the age?
A. It had the age, yes.
Q. And was therefore in a more septic condition than the lower part of the sewage?
A. It would be relatively in a more septic condition, but when a small quantity of sewage appears in a large quantity of water the dissolved oxygen contained in that water will delay septic fermentation considerably.
Q. Well, was it at the same time you made your inspection of the Moon Island outlet?
A. It was the same day.
Q. So that they were both made in mid-summer?
A. Yes.

Q. Is there any hotter part of the year than in mid-summer that you know of?

A. No. That was what I was after, the conditions in hot weather.

Q. At what point did the Moon Island discharge take place with reference to the surface of the bay?

A. The discharge took place at a few feet below the surface, two or three feet possibly. The violent sheet of sewage was issuing from a culvert that was just submerged at the time, and this was causing a very violent agitation of the water in the immediate vicinity.

2690 Q. As favorable conditions as could well be conceived at that point for causing offensive odors, was it not?

A. Yes, I think it would rather facilitate the discharge of odors.

Q. A violent discharge by hydraulic pressure, was it not?

A. Yes, sir.

Q. And you did not at that time notice any especially offensive odors?

A. Oh, yes, at Moon Island the odors were offensive. At Deer Island they were not.

Q. What depth below the surface is the Deer Island outlet?

A. At the time that I saw it it was probably three feet, covered with water. The Deer Island outlet is exposed, or nearly exposed at low water, and the tide at that time had been—it was about one-third in flood, and the rise was about nine feet. I assumed that it was covered about three feet. I did not measure it.

Q. You say you have not made an inspection of the Nutt Island discharge?

A. No, sir, I only saw it from a distance.

Q. Now, the discharge at Moon Island and Deer Island is of purified sewage?

A. Moon Island is partly sedimented sewage. Deer Island there it is not sedimented; it is crude.

Q. Crude?

A. Crude, yes, sir.

Q. Do you know the population that the sewer that discharges at Deer Island served at the time you observed it?

A. I did know, but I do not remember now. I can get the figures for you.

Q. What process of screening, if any, is the discharge at Moon Island subject to, if you know?

A. There is no screening directly at Moon Island. The screening takes place before reaching Moon Island and that is done through gratings, bars, spaced I think they are one and one-half inch or so from center to center, leaving a space of ⅞ of an inch between bars.

Q. Known as rough screening?

A. Yes, sir, I should call it rough screening.

2691 Q. That is the only process that this sewage is subjected to before it is discharged except the retention in the reservoir for the period of a tide?

A. And in addition to that there is a long sewer, a very large

sewer, twelve feet or more in diameter, which is called a deposit sewer, in which a rather large amount of sedimentation takes place before reaching the reservoir. The sediment is removed from the sewer by barges from time to time and is then towed out to sea.

Q. Now, returning to the proposed discharge at Robbins Reef, Mr. Kuichling, you have said that you anticipate a nuisance being created there within New York from the odors there originating?

A. Yes, sir.

Q. When you testified to that as your opinion, on what condition of sewage at that point, with reference to treatment, are you testifying?

A. The assumption on my part was that the sewage should be screened through a grating with bars or meshes four-tenths of an inch apart and the sewage also sedimented in tanks for a period of from 1 to 2 hours.

Q. Anything else?

A. The additional features of the process were coarse screening, and the removal of grit by means of a grit chamber or basin prior to reaching the sedimentation basins proper.

Q. Anything else?

A. That is all.

Q. And is that the condition of the sewage you had in mind upon which you testified that there would also be a nuisance created within the limits of New York by the deposit of matters on the shores of New York?

A. Not with reference to the deposit of matter.

Q. What was the condition under which you anticipated that a nuisance would be created?

A. The deposit of matter would come from the coagulation of colloidal substances that were in solution in the sewage rather than from the deposit of what is termed solids, solid particles in suspension.

Q. Until they were deposited in some way from this condition of colloidal suspension would not be discernible as solid particles?

A. Yes, sir.

Q. They would?

A. They would not be discernible; they would not be discernible by an ordinary examination, but they would be discernible by a refined method of observation. The presence of colloids
3092 can be determined by an apparatus called the microscope.

Q. We do not generally carry that round with us?

A. No, for that reason I state the ordinary plain observation.

Q. When we say visible do you mean that we are thinking of visible by the aid of a microscope?

A. No, and I wanted to state that specifically to eliminate doubt as to whether it concerned being visible in any case. I add the qualification so as to be in accord with your own notion.

Q. In what bulk would matter in a state of colloidal suspension be discharged along the shores of the Bay of New York, in your opinion, from the sewage of the character that you are testifying about?

A. About one-half of the total amount of dissolved matter, dissolved organic matter in the sewage, is in the colloidal state. This being the proportion, the volume cannot be given exactly, because all these are given in weights, it would be one-half of the weight. The volume may be enormously large of the colloids before coagulation. When coagulated they shrink and become a very small volume.

Q. And when deposited on the shores of New York Bay from this sewage discharged in the form of coagulated matter, do you think they would be perceptible to the eye?

A. Oh, yes, I believe it would be perceptible to the eye.

Q. In what length of time would such a deposit be created along the shores, in your judgment, from such matter held in colloidal suspension, so as to be visible to the ordinary eye?

A. Some of the colloids are coagulated almost immediately on coming into contact with salt water.

Q. They should be deposited near Robbins Reef, should they not?

A. No, not near Robbins Reef, because of the strong currents that prevail there at times of extreme tidal motion.

Q. This sewage comes into contact with salt water at that point?

A. Yes, there would be coagulation but not deposits at that point. Deposit would take place at a point where the current becomes much less.

2693 Q. Do you think any considerable amount of this coagulated matter would appear on the shores of the State of New York from the sewage discharged at Robbins Reef?

A. Yes, I should fancy there would be a very considerable amount of it.

Q. And how would it compare with the matter discharged from the crude sewage of the city of New York along the same shores?

A. It would be less, very likely, in bulk, but I cannot say how much less.

Q. Is organic matter held in colloidal solution subject to the action of dissolved oxygen in the water?

A. Some of it is.

Q. Is it more favorably placed with respect to the dissolved oxygen in the water than most organic particles held in ordinary suspension?

A. Yes, generally considered, more accessible to the oxygen by reason of its greater distribution.

Q. How far is the point of discharge at Robbins Reef from the nearest shore of the State of New York?

A. About one mile.

Q. Where is that?

A. New Brighton, the northeast corner of Staten Island. The locality known as New Brighton, Fort George. It is the ferry landing from Manhattan Island to Staten Island.

Q. Where do the sewers of New Brighton or St. George discharge?

A. Most of them discharge into the Kill van Kull, and on the shore of the Upper Bay.

Q. Near the point in question?

A. Yes a little west and south.

Q. And the general direction of the currents is what?

A. The general direction of the current is in this locality north and south rather. North when on flood tide and south on the ebb, the general directions.

Q. On either tide the currents are likely to carry the crude sewage from New Brighton past the point in question?

A. The flood tide, the sewage from New Brighton may pass over the point of discharge of the Passaic Valley outlet.

Q. I am asking you now with reference to the point which is nearest the point of discharge of the Passaic Valley Sewer
2604 either on flood or ebb tide, carrying the sewage of New Brighton past that point, along that point?

A. The flood tide alone will carry it past this point.

Q. That is New Brighton itself you are speaking of?

A. Yes, sir.

Q. Is there any other feature that you have included in your term "nuisance" which in your judgment will arise from the discharge of the sewage from the Passaic Valley Sewer at Robbins Reef?

A. No, I think I have mentioned all the points involved.

Q. They are these coagulations of colloidal matter upon the shores of New York; the odors that you anticipate will arise; and the reduction of the dissolved oxygen in the waters of the Upper Bay?

A. Yes.

Q. And that is all?

A. Yes, with the consequences resulting from all of those actions, which may be innumerable.

Q. What you have heretofore termed "an economic nuisance" may arise?

A. In coagulation, for instance, all colloidal matters will affect the shell-fish. They will also affect the condition of the shores with regard to appearance and growth of seaweeds. The presence of this colloidal matter may also induce putrefaction of the same, if it happens to float near the surface or at the surface, depending upon its specific gravity.

Q. And that will result in what?

A. In giving offensive odors.

Q. That is the same thing, is it not?

A. Yes, that will all come in that way and it will also affect in turn the Planktonal life of the Upper Bay and adjacent waters. Those are the consequences. Each one of those features acts upon another one in the series.

Q. There is no effect, so far as you know, which may not in turn become a cause for some other effect?

A. Precisely.

Q. That is not confined to this sewage problem, is it?

A. It plays a role here, a very important role. It means simply the transference of a nuisance from one point to another. It manifests itself at some different time in a different place, but is traceable to a single original cause.

2605 Q. The odor is a nuisance in itself, according to your judgment?

A. Yes, sir.

Q. It does not matter where it produces a nuisance?

A. Yes, sir.

Q. So that does not come within your latest view of the transference of nuisance?

A. No.

Q. And the discharge of organic matter on the shore by the coagulation of organic matter, that becomes a specific nuisance at the point at which it is so accumulated?

A. Yes, sir, and by its putrefaction also.

Q. That sets up the odor again?

A. Yes.

Q. And that assists or causes the growth of seaweed of different kinds?

A. Yes, which in turn by decomposition may give rise to further offensive odors.

Q. And the deprivation of the plankton in waters of the Upper Bay will cause what, in your judgment, as a result?

A. It will cause the transference of the nuisance to a point where the plankton is able to survive and operate efficiently.

Q. Beyond that what will it do; what evil effect or nuisance will it produce, the deprivation of the plankton which might be efficient in removing the pollution from the sewage that we are considering?

A. With the deprivation of the plankton will follow the destruction of the food elements of vertebrate fish life, and the pollution will then drift with the tides until it gets into water which is equipped with plankton, who secure its final assimilation or digestion.

Q. How far from the point of the discharge of this sewage, in your judgment, will this destruction of plankton occur?

A. That would depend upon the currents. In this case of Robbins Reef Light I should say you would find little in the way of useful plankton in the main current within say a mile or two of the point of discharge in either direction. It might be three miles.

Q. What effect does the discharge of the sewage from the 4,500,000 people within the limits of New York Bay into the waters of
2696 the Upper Bay have upon the plankton of the bay, in your opinion?

A. It has thus far succeeded in producing a reduction in the amount of plankton that would be found if the pollution were less.

Q. In other words, pollution has polluted, in your judgment, is that what you mean?

A. Yes, that is one way to put it. Pollution has polluted, that is self-evident.

Q. That seems to be almost as self-evident as your proposition that pollution has reduced the plankton?

A. There is this, though. A certain amount of pollution improves the growth of the plankton and its development. The plankton is nature's means of eliminating organic pollution from waters, and when the pollution has exceeded certain bounds the plankton begin to disappear, and reappear after the water has become better diluted again.

Q. Well, do you mean by that, Mr. Kuichling, that the sewage itself is the origin of the plankton?

A. Organic matter in solution is the food for plankton, and the means of its subsistence and development and growth. The dissolved organic matter in sewage is food for plankton and plankton organisms, when in a condition not to be poisonous to them——

Q. And the plankton is the food for the vertebrate fishes?

A. Yes, sir, intermediary food, because the vertebrate fishes will usually feed on some crustacea and some of the smaller fishes which feed in turn on some of the more elementary organisms in the plankton. There is a long series of interchanges between the little unicellular algæ, that forms one constituent of the plankton, and the large fish, the vertebrate fish.

Q. Then, within limits, so far as vertebrate fish are concerned, it is rather an advantage to have some sewage.

A. Yes; so regarded by some.

Q. Have you been able to discover what the limit might be?

A. No, I have not found a limit for that. The chief condition seems to be that the sewage should be in fresh condition, that is, not septic, and it should not be mingled with substances poisonous for fish.

2697 Q. Where do you find authority for that statement?

A. I think nearly every recent writer on the subject has stated that fresh sewage is desirable, and that stale or septic sewage is undesirable.

Q. Sewage of what age?

A. Age enough to develop offensive odors. The sulphuretted hydrogen gas is supposed to be the chief poison for animal organisms, including fishes, and septic sewage is usually regarded as being connected with the evolution of sulphuretted hydrogen.

Q. At what age does the production of sulphureted hydrogen begin in sewage?

A. Depending on the temperature. In warm weather the sewage will become septic in five or six hours.

Q. Does the presence of the sewage which results in the growth of plankton reduce the dissolved oxygen in the water?

A. Yes.

Q. Then, within limits, the reduction of the dissolved oxygen below the saturation point is conducive to fish life of the vertebrate type?

A. Yes, in a different locality, however.

Q. In a different locality from what?

A. From where these plankton exist and the sewage exists. Fish life is not inclined to go to the mouth of the sewer and feed on the solid matters, as a general thing. We know that that does sometimes take place. That certain varieties of fish are of the scavenger nature. There are other varieties of fish that shun such localities.

Q. Are the crustacea of the scavenger type or not?

A. Some of the crustacea are and others are not known to be such, and prefer somewhat cleaner food.

Q. And the crustacea are the food of the vertebrate fish that we have been speaking of?

A. Yes, the smallest crustacea, the larger ones are not serious.

Q. You have testified on your direct examination as to a plant known as sea lettuce.

A. Yes, sir.

Q. To what depth does that sea lettuce grow?

A. Sea lettuce starts to grow in comparatively shallow
2698 water, usually, in mud deposits or sand banks that have been polluted. It then is released from its roots and leads an independent floating existence in the water and attains great length, and is found in water of considerable depth, much depth.

Q. How deep?

A. I should judge from the Belfast Harbor the water is in some places forty feet and fifty feet and over that. I should judge that it ca nexist in water to that depth easily, having been found there.

Q. You think it can exist to a depth of fully 40 feet?

A. No, it floats on the water. It is not attached to the bottom at all, but it floats or remains in suspension in the water.

Q. Does it grow after it is separated from its roots?

A. Yes, sir.

Q. Is there any of this variety of sea plant known in the harbor of New York?

A. I have not seen any such, and I have not heard of any such being found here.

Q. Where in your judgment is it most likely to start in the harbor of New York as distinguished from the Bay of New York?

A. I do not quite understand. The harbor takes in all of the waters.

Q. Well, I have been corrected on a number of occasions here by witnesses, and I supposed that you assumed the same view, that New York Harbor included what is known as Newark Bay, which is a separate port of entry, and if I so use it now I suppose you will agree with that proposition?

A. I should say that it would tend to appear in the shallowest waters of New York Harbor.

Q. Where are they located?

A. They are located in the Upper Bay and Newark Bay; also some shallows in the lower bay, but the more shallow portions that I have in mind would be the shallows of the Upper Bay and Newark Bay.

Q. The Lower Bay you do not seriously consider as a habitat for this sea plant, do you; you do not consider the Lower Bay seriously polluted?

A. Well, if there is much pollution along the line of the Ambrose Channel, and that is immediately adjacent to some of the flat places on the Lower Bay between Ambrose Channel and
2699 Coney Island, and also between Ambrose Channel and Sandy Hook—there are a number of places where the water is less than twelve feet deep. There are great areas less than twelve feet in depth along the southern or southeasterly side of Staten Island, an area along the New Jersey shore.

Q. Is the floor of that badly polluted?

A. I know that there is considerable pollution in Raritan Bay, near the head — it. I know that personally.

Q. And do you know of any more suitable place for the development of this sea plant than the tidal meadows and shores of the Newark Bay and the lower Passaic River?

A. Yes, I believe that Newark Bay has too much fresh water in it. I believe the lettuce requires saltier water than is found in Newark Bay.

Q. Have you made a comparison of the salinity of the waters of Newark Bay with those of the Belfast Lough?

A. No, for the reason that I have not determinations of the salinity extensively in Belfast Lough.

Q. You have in Newark Bay?

A. We have some determinations in Newark Bay, but those were not over a long period of time, so that it is hardly possible to make a comparison, but from my knowledge of Belfast Lough I would consider the water is much more salt than it is in Newark Bay.

Q. Well, then, the shallow water about what used to be known as Communipaw and Bayonne, is that in your judgment suitable for the development of these water plants?

A. I have doubt about their lodging there, owing to the influence of fresh water coming from the Hudson River.

Q. Where is it that you are anticipating this Ulva latissima?

A. That may come in on this southeastern shore of Staten Island, and along on Gravesend Bay, and out in the shallows south of Coney Island, also some of the shallows along the Brooklyn shore.

Q. Whereabouts?

A. From the Narrows up to Gowanus Bay.

Q. You think that the discharge as proposed at Robbins Reef will be likely to produce an appreciable additional contamination at those points that you have named, so as to assist materi-
2700 ally in the development of the Ulva latissima?

A. It will produce an increased pollution of those points, and as to whether it will result in the development of the Ulva latissima I am unable to say, because we have not the plant here, and I have not been able to make any experiments with it.

Q. Do not you know of its growing anywhere in this country?

A. I have not heard of its being found in this region, or in any other as far as that is concerned in America.

Q. Is that one of the resultant nuisances that you refer to as likely or possible in your judgment to be produced by the deposit of coagulated colloids or organic matters?

A. No, not the Ulva latissima. I had not that in mind. I was thinking of other sea-weeds.

Q. Will you tell me why you devoted so much of your direct testimony to this particular sea-weed if it has no reference to this proposed discharge?

A. I devoted only, if I remember rightly, only a moderate amount of space to that. I regarded it as a possibility, the development of it here in the future.

Q. You are willing to go on record that you believe it is possible

for that to be developed from the sewage discharge as contemplated at Robbins Reef from the Passaic Valley Sewer?

A. Yes, sir, enthusiastically so.

Q. Now, what did you base that belief upon, that it is possible?

A. I give it on the basis that this effluent to be discharged from the tanks of the Passaic Valley Sewer system will contain a large quantity of organic matter in solution, and that this organic matter will become a source of nuisance in one form or another in the bay.

Q. When you say nuisance in one form or another, you do not refer to anything else than those things you have testified to?

A. Yes, sir; the various chains and inter-combinations of results.

Q. Now, Mr. Kuichling, those are large words and might mean a great deal. The fundamental nuisances, so far as I remember, are odors, deposits of coaguated colloidal matter on the shores, and the reduction of dissolved oxygen. Is there anything else?

2701 A. With that will go bacteria, of course. I omitted to mention that specifically, but whatever bacterial results will come, of course, are to be included.

Q. Are bacteria necessarily injurious and a nuisance?

A. When they are pathogenic they certainly are.

Q. When they are not pathogenic, are they?

A. They become a nuisance by the decomposition of the albumen of which they are composed.

Q. As a matter of fact are they not beneficent when they serve to destroy the organic matter and resolve it into its component parts?

A. Beneficent to that extent.

Q. Now, in this interchange of effects that you have testified to, this primary feature of the nuisance, will you please name the specific things that you refer to outside of odors?

A. Bacteria.

Q. They are a nuisance, are they?

A. When pathogenic they become dangerous and in that respect a nuisance.

Q. In what way are they dangerous when immersed and submerged in sea water?

A. They may come in contact with beds of shell-fish. They will also tend to form a pollution of the water itself.

Q. Now, how do you compare the nuisances in this respect?

A. Just one moment please, because you asked for the whole chain. Bacteria first, the next was the development of sea-weed upon the shore, called generally aquatic vegetation, feeding upon the dissolved organic matter. Third, deposits from the colloidal matter that would be coagulated. The fourth would be the effect upon shell-fish, and the fifth indirectly the effect on major fish life. I think that will embody everything.

Q. That is the nexus that you had in mind?

A. Yes, an outline of it. Of course, I have yet to add the whole chain of planktonal relations.

Q. The effect on shell-fish, is or is not that the same as the

discharge of the malefficient germs into the water, the bacteria that you term pathogenic, is not that the same thing?

A. Yes, shell-fish are affected first by the bacteria, secondly by solid matter, forming the coagulum of the colloidal matter, and then from that the evolution of gas by its putrescence, resulting in the destruction of the shell-fish.

2702 Q. And it is your opinion that such coagulated matter so produced will have a detrimental effect upon the shell-fish in the water of New York Bay?

A. Yes, I believe it will, and I am referring in that answer not only to the Upper Bay, in which the shell-fish industry has been pretty much abandoned, but the lower bay, where it is still carried on.

Q. You think organic matter as discharged from this sewer at this particular point will reach those points where shell-fish are now being propagated in the lower bay, affect them in the way that you have described, so that it can be determined that that is the case?

A. I would not be able to say that it is traceable directly to this organic matter, because there happens to be some other organic matter in the water coming from other sources, but I will put it in this way; If there were not other organic matter in this water then the discharge of the Passaic Valley sewage at the point and in the manner indicated would result in dangers of the classes named.

Q. And any effect of a dangerous character arising from that kind of source would be properly attributed to the Passaic Valley discharge?

A. Yes.

Q. There being no other cause?

A. There being no other cause, of course. I cannot differentiate between different pollutions.

Q. All these aquatic plants that you have testified to as one of the resultants of this discharge, just what are they?

A. They are known under the name of algae, marine algae, and embrace a great variety of species, large and small.

Q. And the effect of this marine algae, so far as it constitutes a nuisance is what?

A. They are liable to be washed in more or less large masses onto the shore in stormy weather and there decay and give rise to offensive odors.

Q. What else?

A. The only other feature would be the fouling of the shore by this deposit of sea-weed. It is not pleasant to the sight any more than to the smell.

Q. It is not, in your opinion, a natural corrective to the de-
2703 posit of organic matter, organic pollution along the shores?

A. The formation of the algae?

Q. Yes.

A. Yes, but in turn their organic matter, when it is dirt, matter out of place, it begins to decompose and gives rise to a nuisance. That is, only when it is out of place.

Q. I think you said you had examined a number of harbors in different parts of the world?

A. Yes.

Q. And this is one of the most polluted that you know of?

A. No, I did not say that.

Q. Do you think that is so?

A. I have seen worse pulluted ones.

Q. This is considerably polluted, in your opinion?

A. Yes, with the sewage of so many people going into it it cannot be otherwise.

Q. Where are these marine algæ being produced so as to constitute a nuisance in the harbor I mean?

A. I have seen great masses of them myself on the shore of Gravesend Bay, and on the shore of Staten Island, the southeastern shore, and at other summer resorts, bathing beaches, I have forgotten the name; Midland Beach, both Midland and South Beaches. I have seen at both those places masses of sea-weed after a storm on the shore, and when those were exposed they were not giving off pleasant odors.

Q. Are these sea-weeds of the character that you have defined as being grown upon deposits of sewage?

A. I do not know whether these particular weeds were grown on such deposits or not.

Q. These beaches where you saw them, are they beaches exposed to the surf from the open sea?

A. Not from the open sea, from the lower bay, if you call that the open sea.

Q. Well, the waves roll in from the ocean?

A. Yes, but the lower bay is not regarded quite as the open sea.

Q. Did you ever happen to visit the Jersey Coast in the summer time?

A. Yes, sir. I have been at Sea Bright, Long Branch.

Q. Asbury Park?

A. No.

Q. Atlantic City?

A. Atlantic City.

Q. Did you find sea-weeds along the shore there?

A. Occasionally.

2704 Q. And at times, after a heavy storm, you find them heaped up?

A. Yes.

Q. Are they offensive in odor?

A. Yes sir.

Q. And of the kind that you saw on these beaches, Midland Beach and South Beach?

A. Somewhat similar. I know about the south shore of Long Island. I can tell you something of the open sea there.

Q. Have you testified as to an inspection of the shores of the bay?

A. Yes, sir, inspections as made by the Metropolitan Sewerage Commission, or the New York Bay Pollution Commission.

Q. Did you make any inspection yourself?

A. I made none, but I have not referred to them except as I have testified to them under cross-examination by you.

Q. Did not you testify to them in your own direct examination?

A. No, sir.

Q. Well, now, do you remember dealing with such accumulations of organic matter as required the burning of them; did you testify to any such instance as that?

A. I do not remember that I have testified to such directly.

Q. Do you remember in one instance of testifying to the burning of refuse at Sea Gate?

A. I think that was in the report of the Metropolitan Sewerage Commission.

Q. Not in your testimony?

A. Not in my testimony.

Q. Well, you have observed that the shores, particularly below the Narrows, are more or less polluted by organic matter?

A. Yes sir.

Q. Garbage or refuse?

A. I would say rather material of the nature of garbage than what is ordinarily known as sewage.

Q. Now, you distinguish then between garbage and sewage?

A. Yes, sir.

Q. Garbage is not sewage?

A. Garbage may be in sewage.

Q. But it is, as distinguished from it, it is a distinct thing?

A. Yes, sir.

Q. And garbage that you have observed at a point below the Narrows, do you know what the source of it is?

2705 A. No; I do not.

Q. Do you know that it comes from the scows of New York?

A. No sir.

Q. Have you ever seen the scows, the garbage scows from New York, dumping out by the narrows?

A. Some years ago I saw them.

Q. You do not see it any more?

A. No, I saw it going to Newark Bay.

Q. You better come down to Long Branch and watch them.

A. Yes.

Q. Now, Mr. Kuichling, taking the results which are specified and stipulated for in the stipulation between the United States and the State of New Jersey and Passaic Valley Sewerage Commissioners, being Complainants' Exhibit No. 135, and assuming that effluent, as so stipulated, to be one discharged at Robbins Reef Light, what nuisances do you anticipate to result from that discharge?

A. They would be much less in number and character and magnitude than if only the provisions named in this contract for the treatment of the sewage were carried out.

Q. Much less in magnitude and character. Would the odors that you have named as one of the nuisances anticipated by you be present in the waters of New York Bay?

A. I should expect some odor to be present at times. The provisions of the stipulations do not say, if I remember rightly, that at all times there will be absence in New York Bay and vicinity of odors due to the putrefaction of organic matters contained in the Passaic Valley sewage thus discharged. I would assume that that would mean the greater part of the time, not all of the time. If I were drawing a specification I would put in at all times. I would assume that it might be the greater part of the year there might be absence of odors.

Q. That is your interpretation of the legal meaning of the third subdivision of the second clause of this stipulation?

A. No, it is my own interpretation of it, from the standpoint of experience rather than as a matter of law. I do not pretend to know much of law. I would say it was almost impossible to secure this result at all times.

Q. And therefore you read into that section that there will be an absence at any time in New York Bay?

2706 A. There will be an absence for the greater part of the time.

Q. That is what you insert in the stipulation?

A. Yes.

Q. And you do that because you believe the strict language of the stipulation is impossible of being carried out?

A. Yes, I think it is practically impossible to carry it out.

Q. Now, what about this matter in colloidal suspension. You think that will continue to be present and to coagulate along the shores of New York, notwithstanding the stipulation?

A. Yes, I believe that it would be fair for the Passaic Valley Sewerage Commission to take advantage of that situation and say we will not remove this colloidal matter until we know that it is going to result in a nuisance.

Q. Mr. Kuichling, where is the coagulation of the colloidal matter likely to occur?

A. It will occur in the waters of the bay soon after escaping from the outlet pipes, and then will be transported by the currents to some distant point.

Q. And when so coagulated at a short distance from the point of discharge, will it or will it not constitute visible suspended particles?

A. That will depend again on what is meant by visible. If I went to look for it, I believe I could find it with my unaided eye, without a microscope or other physical means. Some of this matter in coagulation is seen in a comparatively transparent form, the same as when one puts a drop of mucilage into a glass of water. The mucilage not being colored, still you can see it when held to the light. It becomes visible in that way. But unless one were to define what is meant more particularly by this visibility, I should say it might be overlooked very often. This is a case where an inspector would be liable to overlook it.

Q. Because it is of that transparent nature that you have indicated?

A. Some of it is.
Q. All of it?
A. Not all of it.
Q. That which is not, would that be visible as suspended particles in the water of New York Bay?
A. Yes, it might become visible.
2707 Q. Then the stipulation would not be complied with?
A. Not wholly.
Q. Well, now, I am assuming that it is complied with wholly. I am asking you to assume it.
A. Assuming that it is complied with wholly, of course there would not be any visible suspended particles coming from this Passaic Valley sewage.
Q. There would not be any matter in colloidal suspension?
A. Oh, yes, because the collodial matter might still be there and it might not show its existence until a long time afterwards.
Q. I thought you said this organic matter become coagulated into organic substances within a short distance after it reached the sea water?
A. It does, some does; others take a long time. There are an almost infinite number of organic components of this colloidal nature, and we know of a comparatively small number of them. Their habits and a great majority of the other things we know comparatively little about.
Q. Now, does the coagulation of this colloidal matter result in the production of gases?
A. Not the congulation. The subsequent putrescence results in gases.
Q. Will they be perceptible?
A. Some will be.
Q. Those that will not be, what harm will they do?
A. They may tend to rob the water of some of its dissolved oxygen by going into combination with it.
Q. Remember that you are assuming in this that there will be absence in the reduction of dissolved oxygen contents of the waters of New York Bay resulting from the discharge of the Passaic Valley sewage to such an extent as to interfere with major fish life?
A. I have that in mind, but not in connection with the provisions for treating the sewage.
Q. I am asking only as to the effluent?
A. If we omit what is specified here as to the mode of treatment, and confine ourselves simply to what is here required, that is another thing.
Q. Now, just confining your assumption to the description of the effluent as specified to be produced by the means that are described and by requisite and lawful additional arrangements.
2708 Will that effluent discharged at the point indicated, in your judgment, produce a nuisance in the waters of New York bay, and if so, how?
A. I have no knowledge of what the additional lawful means are, and hence can form no opinion as to what the effluent will be.

Q. Well, Mr. Kuichling, assume that the additional lawful means are such additional means as may be necessary to produce this effluent.

A. In that case there would be a much greater reduction of nuisance or trouble of any kind than I have mentioned.

Q. In what respect would it occasion, in your judgment, any form of nuisance in New York Bay?

A. By bacterial infection, which is not provided for here.

Q. Now, referring to what kind of bacteria?

A. Pathogenic bacteria.

Q. The possibility or the probability of the discharge into the waters of the bay of pathogenic bacteria, that is the only respect?

A. That would be the main item. There is another feature, and that is there is no provision here for the exclusion of that dissolved organic matter. The specifications and requirements require better explanation to me before they can be understood thoroughly. There are a good many omissions in them, and they fail to define exactly what is meant, but taking them as they stand here, I infer that it would be practically filtered water that would come out. But unfortunately there is no provision here for sterilized filtered water. Hence you may have bacterial infection that is not excluded. You have no exclusion of dissolved organic matter, although the manifest meaning of it is filtered water at first reading.

Q. And having that in your mind as the reasonable intent of the stipulations you still say that you think it would set up a nuisance in New York Harbor, do you?

A. It will set up a nuisance to the extent I have described, and under the conditions that I have described.

Q. Is there anything in your judgment, Mr. Kuichling, which will result in an unobjectionable discharge into the waters of New York Bay, being more or less pure, except distilled water?

2709 A. Well, highly filtered water would, I think, meet the requirements.

Q. Would distilled water meet the requirements?

A. Distilled water would, of course, absolutely meet them, but I would not think it was necessary to go as far as that.

Q. Would you think it was necessary to go any further than the specifications in these stipulations as to character of the effluent?

A. Yes, I should deem it necessary to explain at greater length what is meant by these specifications and requirements.

Q. And you have interpreted them, have you not, as being practically filtered water?

A. A cursory reading gives one the impression that that is what is meant and called for, filtered water. A closer reading, in connection with the other features in the case, leads me to believe that considerably less will be required than filtered water.

Q. That is your practical judgment, is it, as to what actually will be required?

A. Yes, it is my practical judgment.

Q. Now, Mr. Kuichling, you have testified, as I remember your testimony in this case, as to the devices for the discharge of the

sewage at Robbins Reef. As you understand it, is that discharge to be horizontal or vertical?

A. Vertical. The pipes are more or less horizontal, with vertical nozzles attached to them, and the nozzles are conical in shape. The discharge is not absolutely vertical but at a slight angle to the taper of the cone.

Q. Will you take your copy of Exhibit No. 135 in this case and see if I read what you had before you. I am now reading from subdivision C of the first general paragraph:

"The sewage and waste thus screened and settled is then to flow into a pump well, from whence it is to be pumped under pressure through the tunnel to a point in the New York Bay near Robbins Reef Light, at which point it is agreed that the matter passing through the said tunnel shall be dispersed into the waters of the New York Bay through a series of outlets discharging forty feet or more beneath the surface of the water at mean low tide,
2710 From the end of the tunnel connections shall be made with four or more discharge pipes extending across the current, spaced about one hundred feet apart, laid in trenches on the bottom of the Bay, and of a size decreasing in diameter from about six feet to two feet. On the top of these discharge pipes will be a series of not less than one hundred and fifty tees of a diameter not exceeding one foot, and spaced approximately ten feet apart. On each of these vertical tees shall be placed outlets arranged to discharge horizontally across the tidal current and the extent of the dispersion area used for this system of outlet pipes shall cover at least 3.5 acres of the bottom of the Bay." Do you now say that the discharge is to be a vertical discharge?

A. I mean to say that the plan that I have seen that had the discharge of this outlet does not agree with this provision either in the side of the outlets or in the direction of the outlets or in the area.

Q. Well, you have had this stipulation before you?

A. Yes, sir. The plan I saw was made after this agreement was drawn, and the plan was signed by Edlow Harrison, chief engineer of the Passaic Valley Sewerage Commission.

Q. When did you see that?

A. I saw that last fall.

Q. And when was it made?

A. I think the plans were dated in 1909 or 1910, I do not remember definitely.

Q. Will you look at the date of this stipulation and say whether that plan was made before or after this stipulation was entered into?

A. I cannot say so.

Q. Well, you did say so; do you want to change your testimony?

A. Yes, 1909 or 1910, I do not know which it was I said.

Q. Do you want to correct that?

A. Yes, sir. I will say in connection with this that I had another date in mind. It was October, 1909. I see here in the heading, the copy that I have of this agreement, it says Supreme

Court of the United States, October Term, 1909. The date of the execution of the agreement is left blank in the copy that I have, and I supposed it was simply tried in October and this made in October, 1909.

Q. Is that a scientific method in getting at basic facts to assume figures on matters of this sort?

2711 A. No, sir.

Q. You saw in that stipulation, did you not, that the discharge was to be horizontal?

A. Yes, sir.

Q. Why did not you investigate to find out whether or not that stipulation had been superceded?

A. Because I did not think it was worth while to do it. It did not make any difference in my mind whether it was vertical or horizontal.

Q. You have dwelt on your direct examination on all the features of the discharge?

A. Simply the features of the discharge in describing it. The project, as I understood, was to be described, and nothing further was in my mind than to set forth what I understood it was the plan to carry out.

Q. Why did you mention it if it did not make any difference whether it was vertical or horizontal?

A. Because it did not occur to me. I did not think it of sufficient importance practically.

Q. You thought it of enough importance to put in the word vertical when there is not anything in the stipulation which justifies the use of any other word than horizontal?

A. No, because I supposed that possibly the engineers of the Passaic Valley Sewerage Commissioners, in drawing such plans, had agreed with the representatives of the United States Army Engineering Corps that their plan was preferable to what was set forth in this agreement.

Q. Now, Mr. Kuichling, you have testified to the laudable nature of any project to free the Passaic River and Newark Bay from pollution. You said that was laudable I think?

A. Yes.

Q. What plan had you in mind, if any, to accomplish that result?

A. I had not any in mind. I had not studied the proposition from that standpoint.

Q. Do you know of any plan for the disposal of sewage which does not involve an effluent of some character?

A. No, except evaporation.

Q. Do you think evaporation is adaptable to the sewage of the character and amount of the Passaic Valley?

2712 A. No.

Q. So that you do not know of any practical method that will relieve the Passaic River and the Newark Bay from its extreme pollution, except by the production of an effluent?

A. I want to qualify that by saying that the betterment of the Passaic River can be obtained by treating the sewage of each com-

munity in such manner as to produce an effluent that will not add polluting matter beyond the capacity of the stream to assimilate and absorb.

Q. And that effluent which you have described, is it of a more stringent character than that which is stipulated for in the stipulation which is in evidence in this case?

A. I should make much less stringent stipulations.

Q. And you would not hesitate to discharge the effluent into the fresh water streams which empty into the Passaic River?

A. No, I think I would not.

Q. You said I think that effluent would cause nuisances in those streams?

A. It would depend upon the flow of the streams, and the amount of effluent that is put in. What might be true and hold at the present time, the year 1912, might not hold for the year 1940.

Q. Well, where would you put your disposal plant for the city of Newark, for instance?

A. I have not given the matter close consideration, but the first study that I made of it for my own information was to locate it on the Meadows.

Q. About where *do* you understand the filtration plant is to be located?

A. Yes.

Q. So, to that extent, you agree with the engineers of the Passaic Valley Sewerage Commissioners?

A. Yes, sir.

Q. Now, having established a disposal plant for 47 per cent. of the sewage of the district, do you think that you would construct individual disposal plants for all the rest of them?

A. I have not given the subject the necessary thought to answer the question in a satisfactory way.

2713 Q. Well now, the effluent from this one city, Newark, that you have tentatively located, where would you discharge that?

A. The ultimate effluent would go into Newark Bay.

Q. Of course, that would be subject to the approval of the War Department?

A. Yes.

Q. And you had no question about that effluent not creating a nuisance in Newark Bay?

A. I believe that it would create no nuisance in Newark Bay.

Q. And would it be of a character as stringent as that specified in this stipulation.

A. It would be somewhat less stringent in some respects, but it would call for other means of treatment than are named in this instrument.

Q. Manifestly. I am now speaking of the description of the effluent?

A. Yes.

Q. Would it be more stringent than that?

A. I do not believe I would make it quite as stringent as that.

Q. And you think that would not create any nuisance in Newark Bay?

A. I do not think it would.

Mr. Riker: That is all.

Mr. O'Sullivan: That is all.

JOHN W. ALVORD, a witness called on behalf of complainants, being first duly sworn, testified as follows:

Direct examination by Mr. O'Sullivan:

Q. Where do you reside?

A. In the city of Chicago, Illinois.

Q. What is your profession?

A. Sanitary and hydraulic engineer.

Q. Will you state your training and early experience as an engineer, Mr. Alvord?

A. My early work was in connection with the Chicago Water Works. Assistant to chief engineer on lake inlet tunnel and pumping stations in Chicago—at the Hyde Park Station 1880-1881; Lake View Pumping Station 1884-1888. As assistant to chief
2714 engineer of Hyde Park and Lake View (now districts of Chicago); had charge of construction of large brick main trunk sewers.

In 1884 appointed city engineer of Lake View, now Chicago. Designed extension of sewer system; remodeled and extended water works to fourfold its original capacity; superintended street paving, lake shore protection, and lake shore boulevards. Expenditure of about $2,500,000 during term of office.

After the annexation of suburban districts to Chicago in 1888, spent nearly a year in Europe in examining public works, collecting data on sewerage and sewage purification. Visited sewage purification works at Berlin, Paris, and nineteen sewage purification works in England, including Manchester, Birmingham, Coventry, Acton, London, York, and other places.

In 1889 was appointed chief engineer of Cicero, a town west of and adjacent to Chicago. Designed a sewer system of 380 miles total length—storm water sewers. Built several of the main trunk sewers during term of office. Delegate to Peoria Convention which originated waterway and sanitary legislation for Chicago.

In 1890 was appointed chief of an engineering department of the World's Columbian Exposition at Chicago, having charge of the dredging, grading and filling of the grounds, and construction of the roads, surveys, and grades; kept records of sewer and water construction, and had under observations a sewage disposal plant. At dedication ceremonies was presented with one of the seventy medals received by the designers of the World's Fair. At this time was chief engineer for a company which constructed a water pipe line of nearly one hundred miles in length, from Wisconsin to Chicago, for supplying the World's Columbian Exposition.

At the close of the Exposition compiled the Report of the Director of Public Works.

2715 In 1894-1895 was consulting engineer to a land company, formed for the purpose of reclaiming marsh lands between Jersey City and Newark, New Jersey. Made extensive examination and report on this work; also report on irrigation projects at Granger and Green River, Wyoming.

Adjourned to July 1, 1912, at 10.30 A. M.

Supreme Court of the United States, October Term, 1911.

THE PEOPLE OF THE STATE OF NEW YORK, Complainants,
against
STATE OF NEW JERSEY and PASSAIC VALLEY SEWERAGE COMMISSIONERS, Defendants.

Before James D. Maher, Esq., Commissioner.

CORPORATION COUNSEL'S OFFICE.
NEW YORK CITY, July 1, 1912—10.30 o'clock a. m.

Appearances:

Dr. William J. O'Sullivan, Special Counsel for the People of the State of New York, Complainants;
Adrian Riker, Esq., Of Counsel for Passaic Valley Sewerage Commissioners, Defendants.

2716 Met pursuant to adjournment.

JOHN W. ALVORD, a witness called on behalf of complainants, recalled for further examination, testified as follows:

Direct examination by Mr. O'Sullivan (resumed):

Q. Mr. Alvord, have you been engaged as a consulting engineer?
A. Yes, sir. From 1897 to 1901 was consulting engineer to the Illinois and Michigan Canal Commissioners, conducting successful litigation with the sanitary district of Chicago, and advising on construction of water power and various other public works in connection with the canal. Extensively engaged in the apportionment of water powers, and the study of the navigation of the Illinois River during this time.
Q. What sanitary work have you been engaged on, Mr. Alvord?
A. In 1889 was engaged by the City of Columbus as consulting engineer, and designed a system of sewers for the west side of the city, covering some 75 miles of sanitary sewers, including a pumping station, and storm water drains. Published a report, with detailed plans and estimates for the purification of the sewage of the entire city, at a proposed cost of about $500,000. Made extensive studies of sewage purification at this time, reviewing English experience, and

calling attention for the first time in a published report to the more recent biological methods in use in England.

Consulting engineer to contractors on construction of Highland Park Reservoir No. 2 at Pittsburg, Pennsylvania. Expert to the United States Government on condemnation cases in connection with a water power at Sterling, Illinois. Employed by the Expert Commission reporting to the City of Chicago in designing an intercepting system of sewers, costing several millions of dollars.

In 1889 was engaged by the Dubuque Water Company in charge of their interests before an arbitration board. Following this
2717 was appointed appraiser in the following cases: Sheboygan, Wisconsin; Lake Forest, Illinois; Marysville, Ohio; Flint, Michigan; Quincy, Illinois; Mobile, Alabama; Omaha, Nebraska; Waterville, Maine; Des Moines, Iowa; Peoria, Illinois; Kankakee, Illinois; North Platte, Nebraska; Fort Smith, Arkansas; Baton Rouge, Louisiana; Keokuk, Iowa; Richmond, Indiana; Indianapolis, Indiana; Suburbs of Philadelphia; York, Pennsylvania; Knoxville, Tennessee; Macon, Georgia; Vicksburg, Mississippi, and other places, and in all have valued about fifty million dollars' worth of water works property in some 32 or 33 different cases.

Was employed by the United States Steel Corporation to design and construct a water supply and sewerage works for their new city of Gary, Ind. This sewer system covered 25 square miles of territory; a considerable portion of which, covering about 2 square miles of territory, were built under my supervision. An elaborate system of sewage purification was planned in connection with these works, which, however, has not as yet been built.

The water supply, consisting of an inlet tunnel three miles long conducting the water from Lake Michigan to the center of the city, at which point a pumping station raises it into a water tower and in the mains, was also constructed. The total costs of these works was about $1,250,000.

At Rockford, Illinois, was a member of a commission of three engineers, who made a report upon the increase of the water supply of that city.

Have examined and reported on works for the Union Water Company of California supplying extensive districts on the East Bay Cities region.

Am a member of a commission entrusted with the study and supervision of construction of a new additonal supply for the city of Oklahoma, Oklahoma.

Reported on new additional supply for the city of South Bend, Indiana. As chief engineer, have designed and constructed a new filtration plant of 12 million gallons daily capacity, costing
2718 about $325,000, for the city of Evansville, Indiana. This plant was constructed upon very difficult foundation work, and our work included re-building the station and installing new pumping machinery.

As consulting engineer to the City of Rock Island designed and advised in the letting of contracts for new six million gallon filtration plant.

Have been consulting engineer for the Des Moines Water Company, Des Moines, Iowa, for the past six years, superintending and designing the construction of extensive additional filteration galleries for the City of Norway, Michigan, a new gravity water supply, costing about $60,000.

Am at present engaged in improving and enlarging the water supply at Richmond, Indiana, Lexington, Kentucky; South Milwaukee, Wisconsin; and have reported on new supplies for the City of Grand Rapids, Michigan; Manistee, Michigan; Benton Harbor, Michigan; Minoma, Minnesota; and Holland, Michigan.

As consulting engineer, advised the Board of Water Commissioners of Niagara Falls, New York, as to their new filtration plant, and drew specifications and general plans therefor.

Q. Have you been engaged, Mr. Alvord, on any general sewage work?

A. Have constructed and designed sewer systems in some 80 different municipalities in one capacity or another, the following of which is a list. These covered about 1500 miles of sewers actually constructed, as well as many more designated and generally planned.

Hyde Park, Ill., (now Chicago)	1880–1884
Lake View, " " "	1884–1888
Buena Park, " " "	1886
Edgewater, " " "	....
Ravenswood, " " "	....
Rogers Park, Ill. " "	1889
Oak Park, Ill.	....
Austin "	....
Clyde, "	....
Berwyn, "	....
Ridgeland, "	....
Highland Park, Ill.	1890
Lake Forest, "	....
East Jersey Land Co., Trenton, N. J.	....
2719 Culver Military Academy	....
Belvidere, Ill.	1895
Holland, Mich.	1896
Charles City, Iowa	....
Crawfordsville, Ind.	....
Havana, Ill.	....
Winnetka, Ill.	1897
Princeton, Ill.	....
Sycamore, Ill.	1898
Columbus, Ohio	....
Downers Grove, Ill.	....
Independence, Ia.	1899
Morris, Ill.	....
Holland, Mich.	1900
City of Chicago (intercepting sewers)	....
Galesburg, Ill.	....
Lombard, Ill.	....

Wauwatosa, Wis. ....
Galva, Ill. ....
De Kalb, Ill. ....
Delphi, Ind. ....
Danville, Ky. 1901
Clearing, Ill. ....
Fairmount, Minn. 1902
Waukegan, Ill. ....
Lake Forest, Ill. ....
Winona, Minn. ....
Polo, Ill. ....
Shorewood, Mich. 1903
Grand Haven, Mich. ....
Millville, N. J. 1903
Bluefield, W. Va. ....
Pekin, Ill. ....
Tomah, Wis. 1905
Chicago Heights, Ill. ....
Washington, Iowa ....
Madison, Wis. ....
West Allis, Wis. ....
Saratoga Springs, N. Y. ....
Indianola, Iowa ....
Kenilworth, Ill. ....
Bluefield, W. Va. ....
East Chicago, Ind. ....
Elgin, Ill. 1906
Monmouth, Ill. ....
Lake Forest, Ill. ....
Georgetown, Ky. ....
Gary, Ind. ....
Bloomington, Ind. ....
Richmond, Ind. ....
Coldwater, Mich. ....
Riverside, Ill. ....
Paducah, Ky. 1907
Farwell, Texas ....
Kenosha, Wis. 1908
Winnetka, Ill. ....
Clearing, Ill. ....
Waupaca, Wis. 1909
2720 South Milwaukee, Wis. ....
Tolleston, Ind. ....
Gary, Ind. ....
Bloomington, Wis. ....
Antigo, Wis. ....
Milwaukee, Wis. 1910
Pekin, Ill. 1910
Madison, Wis. ....

Q. State what sewage purification practice you have been engaged in?

A. Member of a Board of three engineers who have reported on the sewage disposal and protection of the water supply of the City of Milwaukee; advising detailed works, consisting of intercepting sewers, sewage purification plants, pumping stations, costing ultimately upward of thirteen millions of dollars.

Consulting Engineer to the city of Gary, Indiana, and advised on the proposed construction of new sewage purification plants for that entire district.

Have just completed small sewage purification plants at Bloomington, Indiana, and South Milwaukee, Wisconsin, also designed and superintended the construction of a sewer system for Pekin, Illinois.

Have built some 19 or 20 sewage purification plants for smaller cities and larger institutions. The following is a partial list:

Lake Forest, Ill.....Septic tank and sand filters.
Wauwatosa, Wis.....Septic tank and sand filters.
Bloomington, Ind.....Biolitic tank, contact beds, and sprinkling filters.
De Kalb, Ill.....Septic tank.
Belvidere, Ill.....Intermittent sand filtration.
Holland, Mich.....Two septic tanks.
Crawfordsville, Ind.....Small sewage purification plant.
Winnetka, Ill.....Designed two sewage purification plants (since built).
Princeton, Ill.....Designed and built a septic tank. In operation some 13 years.
Sycamore, Ill.....Designed sewage disposal plant. Not yet constructed.
2721 Galva, Ill.....Designed small sewage purification plant (since built).
Danville, Ky.....Built three sewage purification plants, with septic tanks, which have been in operation some nine years.
Fairmount, Minn.....Designed two sewage plants for separate outlets, septic tanks and intermittent filters.
Polo, Ill.....Designed small biolitic tank with radial outflow, followed by contact beds.
El Paso, Texas.....Septic tank, followed by intermittent filtration.
Blufield, W. Va.....Designed two septic tanks for east and west outlet sewers, followed by contact beds. Plants in operation eight years.
Washington, Iowa.....Designed septic tank and contact beds.
Indianola, Iowa.....Passed on design of sewage purification plant.
Tomah, Wis.....Designed and constructed a sewage reduction tank. In operation four years.
Georgetown, Ky.....Designed septic tank.

Richmond, Ky.....Designed septic tank.
Indianapolis, Ind.....Consulting engineer on sewage disposal plant for railroad shops.
Farwell, Texas.....Designed and built small septic tank, dosing chamber, and intermittent sand filters.
Kenosha, Wis.....Report on the pollution of Kenosha harbor, with recommendation for its abatement by means of intercepting sewers and sewage disposal plant.
Kenosha, Wis.....Built septic tank for very large tannery.
South Milwaukee, Wis..Built sewage disposal plant, consisting of a radial flow biolitic tank, with automatic dosing chamber, and intermittent sand filters.
Butler, Wis.....Designed sewage disposal plant for the Chicago & Northwestern Railroad Shops.
Antigo, Wis.....Report on sewage disposal plant for the City, with estimates of cost.

2722 Miscellaneous smaller sewage disposal works:

Glen View Golf Club.....Golf, Ill.
Ravisloe Golf Club.....Homewood, Ill.
Residence, Edward Lowe.....Grand Rapids, Mich.
" Harold F. McCormick.....Lake Forest, Ill.
" L. M. Williams.....Highland Park, Ill.
" E. F. Gorton.....Geneva, Ill.
" Geo. A. Fox.....Sycamore, Ill.
Forward Movement Park.....Saugatuck, Mich.
Epworth Beach.....Ludington, Mich.

Q. Now, Mr. Alvord, will you state what miscellaneous sanitary work you have been engaged in?

A. Investigated typhoid epidemic at Wequetonsing, Michigan, successfully, 1903; Culver Academy, Indiana, 1904; Duluth, Minnesota, 1889, and Hurley and Ironwood, Michigan, 1889. Also reported to Citizens' Committee on the pollution of the Desplaines River, 1907. Also reported to Citizens' Association on the pollution of the Fox River, 1911.

Retained by the cities of Madison, Wisconsin, Lake Forest, and Montmouth, Illinois, as expert in the defense against the suit of the Cameron Septic Tank Company for infringement of certain patents on septic action. In connection with this case, made an extensive study of the past history of the art of sewage purification and patents thereon; the development of methods, and means of sewage purification in England and on the continent.

In 1907 was employed by the Chicago, Milwaukee & St. Paul Railroad to report on the water supply of the City of Seattle, with reference to the protection of its purity, and the sanitation of camps

during construction. This report found in the proceedings of the New England Water Works Association, Volume 20, No. 4.

In 1903 was employed as expert on sewerage and sewage disposal to testify in behalf of the City of St. Louis, in its suit against the Sanitary District of Chicago.

Q. Mr. Alvord, have you been honored in any way by the members of your own profession?

A. Past President of the Illinois Society of Engineers and Surveyors, two terms; past president of the Western Society of Engineers, 1910, one term; president of the American Water
2723 Works Association, 1910, one term; member of the so-called "Merriam Commission," investigating city expenditures, appointed by the Mayor of Chicago, in 1910; member of the American Society of Civil Engineers since 1893; member of the American Public Health Association; member of the American Society of Municipal Improvements and the New England Water Works Association; Fellow of the American Association for the Advancement of Science; member of the American Academy of Political and Social Science; member of the Illinois Water Supply Association.

Q. Have you contributed to the literature of your profession, either in papers or books or pamphlets, matters of that kind that have been printed and distributed among your own profession?

A. Author of the following papers on sewage disposal and relative sanitary subjects:

Sewage Disposal. A discussion, Subject 14, Paper 1. International Engineering Congress, St. Louis, Oct. 3 to 8. Proc. Am. Soc. C. E., Vol. LIV., p. 242.

Sewage Purification Plants. Jour. Wes. Soc. Engrs., April, 1902, Vol. VII., p. 113.

Sewage Purification. An illustrated lecture before the students of the University of Wisconsin, 1905. Reprinted in Municipal Journal and Engineer, 1905.

The Practical Operation of Sewage Purification Plants. Oct. 10, 1902. Proc. American Soc. of Municipal Improvements, Rochester, 1903. Reprinted in Engineering News and Eng. Record.

Sewage Purification Plants for Summer Cottages. 18th Annual Report, Illinois Society, Jan., 1903, p. 60. Reprinted Engineering News same year.

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Q. Mr. Alvord, what familiarity have you with local conditions relative to New York Harbor waters?

A. I resided in Jersey City in my boyhood and in Brooklyn in early manhood, and have crossed the East and North Rivers and the bay many times. In 1888, being then engaged particularly in the study of sewage disposal plants abroad, I examined a sewage disposal plant at East Orange, then in operation, and since discontinued. In the year 1894 I was engaged by capitalists to work on projects for the reclamation of the entire Jersey Meadows between the Hackensack and Passaic Rivers—about 6,000 acres. This work in-
2725 volved the study of the geologic and topographic conditions, early reports made upon the project, surveys of the district and estimates of the cost of converting it into sites for manufacturing, commercial and residential purposes. This work occupied me, I believe, the whole of one summer.

Q. What recent examinations have you made of the waters of New York Bay and the territory of the Passaic Valley?

A. On August 30, 1911, in company with Professor Earle B. Phelps and Professor Edward Ellery, I embarked in a small steamer at Pier A of the Dock Department, North River. The wind was from the northeast and moderate. The flood tide was running. We proceeded first up the East River, observing that the water near the slips was foul and polluted, but not at this point containing much floating matter and no perceptible odor. There had been a recent heavy rain the day before. Near Williamsburg Bridge, observed the large Brooklyn sewer at the pierhead where it discharged a considerable field of floating sewage, fecal matter, trash, and other substances commonly found in and about the mouths of discharging sewers. The field covered by this flow was not distinctly marked at its boundaries, as was the case with some of the other sewers observed.

11.20 A. M., off 72nd Street, Blackwells Island, in the west channel, I drew a sample of water containing infusoria and some other transparent matters; some odor, considerable floating matter observable at this point; wood, lemon peel, oil, chips; color of the

water was olive green and was obviously well filled with fairly fresh sewage.

11.30 A. M., off 110th Street, drew another sample which contained clear evidence of undecomposed sewage, and there was evidence of undecomposed sewage floating about us at this point, a large field discharged from some adjacent sewer. There was a distinct odor of sewage in the air.

At 11.45 A. M., at Harlem River and 149th Street Bridge, we drew a sample containing suspended matters and with some odor.

2726 There was here present floating fecal matter; distinct sewage odor to the atmosphere; river foul and obviously well impregnated with sewage.

We passed from thence to the Hudson River and at 1.10 P. M., opposite Grant's Tomb, took sample containing suspended matters, some odors, but generally better than preceding conditions in Harlem or East River.

At 1.50 P. M., at 42nd Street, detected strong sewage field of very turbid water, with much visible floating matter and evidences of fresh sewage discharge. There was a distinct line of difference between the outer edge of this field of sewage and the ordinary water of the river. From this time onward we went into increasing fields of sewage, which grew more and more intense as we proceeded south. Some of the slips into which we went were extremely foul and odors very nauseating. Generally, the obvious pollution extended from 300 to 400 feet outward into the river, and it was interesting to observe that the mixing between the discharged sewage and the clearer waters was slow and ineffective. In the late afternoon of the same day, in the same company, I proceeded on one of the steamers down the harbor passed Robbins Reef, through the Narrows to Atlantic Highlands and returned. The waters of the Lower Baby were much clearer than the waters of the East or North Rivers and it was more difficult to determine sewage contamination by the senses. There was, however, obviously an improvement of the water as we proceeded southward.

On the 5th of September, 1911, in company with Mr. Desmond FitzGerald, Mr. Harrison P. Eddy, Mr. Weston, and Doctor Provost and Professor Edward Ellery, I left New York at 9 A. M., and proceeded to Newark on the Pennsylvania Railroad. At Newark we all took an automobile and proceeded to Newark Bay at the foot of Doremus Avenue, which is near the site of the pumping station to be erected by the Passaic Valley Sewerage Commissioners. The water of the bay was nasty, discolored and dark. Samples showed that it was well filled with suspended matters; strong vegetable odor; a musty smell was detected. We viewed the possibilities of sew-

2727 age purification on this site and discussed them to some extent. We then proceeded about 11 o'clock reaching Jackson and Fourth Streets Bridge, Newark. It was ebb tide. There was here a very foul condition, the waters black, much visible pollution, floating fecal matter, considerable gas-house waste, oils and other deleterious substances, making the river decidedly obnoxious.

At 11.20 we reached Clay Street Bridge, East Newark. The tide was ebbing. Wind was southwest. The water was black and sewage laden. There was observed old shoes, garbage, fecal matter, sticks, peel; ordinary smell was quite sickening.

At 11.45 we again came to the river opposite Mt. Pleasant Cemetery on the river road opposite paint works. The river was docked on both sides, width about 350 feet. There was a horse-shoe shaped sewer came in on the west side; the water was black and oily; there was ebullition of gas showing septic conditions; there was some gas waste. Boats hereabout were badly discolored by the action of the gases from the decomposition and considerable scum collected in quiet places along the shore. At 12 o'clock at the white bridge at Arlington, in East Bellevue, we again came to the river. The water was also black, ebullition was marked, and there was evidence of gas waste. The tide turned about noon. The banks which were exposed here were very foul and black.

At 12.15 we passed the old Jersey City Water Works, now abandoned. They were built in 1854 and rebuilt in 1862.

At 12.25 we passed the old Newark Water Works on the west bank, now also abandoned. At 12.40, just below the Erie Railroad Bridge in Passaic, we found the river at low tide with the banks not perhaps so black and ugly as below. There was, however, visible polluting matter, odor to some extent, a dark yellow color, visible suspended matter.

At 2.20 P. M., in Passaic, at Monroe Street and Canal, we noted that the water was black to yellow in sample collected. We observed light suspended matter, but not so much odor as below.

2728 At 2.34 P. M., at the Dundee Lakes we noted the water above and below the Dundee Dam. Odors here of the water were vegetable and organic, much less suspended matters than we had hitherto observed, some oil observable on the surface, and some ebullition of gases, however, were detected. At 3.27 P. M., at the Main Street Bridge, Paterson, we observed the river about 100 feet wide running at the rate of 2 feet per second was much clearer. There was, however, a little sediment in the sample collected; the color was yellow; odor vegetable and considerable floating matter on the surface.

At 4.45 at the Great Falls, Paterson, we observed that there was running now a good volume of water, the color was yellow, the odor was not fresh, and there was some vegetable suspended matter, though not marked. The odor the sample gave was musty.

Q. Have you made any more recent trip than the one you have described, Mr. Alvord?

A. Yes, sir. On June 27, this latter week, in company with Professor Mason, at 10.15 A. M., on the Dock Department steamer "General McClellan" for a trip to Gowanus Canal and the shores of the bathing beaches on the Brooklyn side of New York Harbor. High tide was at 7 A. M., the wind northwest. From the Battery to Brooklyn I noticed that the water was sewage laden. There was floating fecal matter observable, a yellow and green color, much trash. At Hamilton Avenue, at the mouth of Gowanus Canal, where

the water is pumped into the harbor, there were very foul conditions, gas waste, papers, floating fecal matter, black color, strong odor, ebullition of gas. We followed around in the east basin, around into Gowanus Canal, and opposite the New York Dock Company observed a floating bath house, No. 4, situated in very foul water, with much floating trash and fecal matter readily observable. These baths were open and being used. Near the mouth of the Gowanus Canal, opposite 36th Street, Brooklyn, we observed — dredge bringing up from the water foul black masses of dredgings from the bottom of the harbor. The water all around was blackened by the dredg-
2729 ings, and there was much ebullition of gas. In the Gowanus Canal we observed the conditions there were not by any means obviated by the works and the pumping station, but much foul floating matter, trash, and fecal matter was observable.

At 11.35 P. M. we visited Brooklyn bathing beach, south of Gowanus Canal. There is here a mooring place for motor boats and some bathing. The water was turbid and discolored and not inviting. There were some gas bubbles and the color was dark. It was noticeable, however, that the water was worse beyond the pier-heads than inshore near the bathing beach.

At 12 o'clock we proceeded to Robbins Reef Light, and then returned to the Battery.

Q. Have you studied the Passaic Valley Trunk Sewer problem as regards the sewer contemplated by the Passaic Valley Sewerage Commissioners?

A. In my general practice as sanitary engineer I have taken occasion to follow the discussion of this problem and found from time to time in a general way of the reports made upon it in my library and have noted all the more important steps which have been discussed and taken. Among these is the report of the sewage disposal of Bridgetown, by Alexander Potter in 1888, and the report of the Passaic Valley Sewerage Commission by Mr. Ftelley and Mr. Jacobson in 1896; the report of the Passaic Valley Sewerage Commission by Mr. Hering in 1907; the report of the sewage disposal of East Orange, Montclair, Glen Ridge and Bloomfield and Orange by Mr. Harrison P. Eddy in 1910; the report of Colonel William Black and Professor Earle B. Phelps on sewer outlets and discharge into New York Harbor, in 1911; the report of the sewage disposal of Orange, Montclair, and East Orange by Mr. Fuertes in 1911; the report on the sewage disposal for Paterson, New Jersey, by Mr. Allen Hasen in 1906.

Q. Mr. Alvord, you have just mentioned the reports of Mr. Eddy, Colonel Black, Professor Phelps and Mr. Fuertes which are already in evidence in this case. Have you yourself made any investigation into the minimum sewage flow for the Metropolitan District
2730 as included in Complainants' Exhibit No. 125?

Mr. Riker: The question is objected to as immaterial and irrelevant. The Metropolitan Sewerage District is not recognised to exist in any way, and inquiry as to its sewage has no probitive value in this case.

The Commissioner: Note the objection of counsel for defendants.

A. I have. In obedience to the request of some of the gentlemen connected with this case I investigated particularly the question as to whether the dry weather sewage flow in the Metropolitan District is not less than 125 gallons per head per day, and I have here the report which I made to the experts in this case. This report goes into detail into the amounts of sewage produced per capita by the various communities in the Metropolitan Sewerage District, including in that term the Passaic Valley. All the communities which drain into the Newark Bay. The studies include infiltration of ground water, the water supply, allowance for ground water, infiltration, made in various cities. The industrial wastes, the sewage flow per capita in various cities, and the conclusion.

There is also a table showing the population and water consumption per capita daily in various cities. The per capita water consumption for various communities in the Metropolitan Sewerage District, including the State of New Jersey. Gaugings of dry weather flow of sewers and an appendix containing extracts from report of the Milwaukee Sewerage Commission on the quantity of sewage likely to be produced, which is investigation along precisely similar lines.

Q. What does that report show as to the per capita sewage. Does it show the largest amount feasible, or the smallest possible amount feasible?

Mr. Riker: The question is objected to on the ground that the report is not in evidence as it stands, and that what — purports to show is not competent, material or relevant at this stage.

The Commissioner: Note the objection of counsel for defendants.

A. It is an attempt to show the least possible amount of sewage per capita which would be likely to be produced by com-
2731 munities of the character and surroundings of those in the Passaic Valley, and adjacent to the harbor of New York.

Mr. O'Sullivan: I offer the report produced by this witness and made by him in evidence, and ask that it be marked Complainants' Exhibit No. 158 in evidence.

Cross-examination by Mr. Riker:

Q. Who did you say made this report?

A. I did.

Q. To whom?

A. To the so-called Central Committee of the experts employed in this case by the State of New York and the Metropolitan Sewerage Commission of the City of New York.

Q. It purports to contain what, in a general way?

A. It contains a study on the least possible allowance of sewage produced in communities of like character to those surrounding and draining into New York Harbor.

Q. Your studies?

A. Largely my studies, and the results of other reliable studies.

Q. Other reliable studies, do you say?

A. Yes, sir, studies which I regard as reliable.
Q. And your own conclusions on them?
A. And my own conclusions on them, so far as relates to the least allowable amount.
Q. Has this report been published?
A. No.
Q. Has it been accepted by any scientific body in any way?
A. No.

Mr. Riker: The report is objected to on the ground that evidence of fact and opinion cannot be given legally in this way and on the ground that it is incompetent, immaterial and irrelevant, and purporting to contain matters of fact within the knowledge of this witness and conclusions as to facts taken from other sources not proved, an expert opinion upon such alleged facts.
The Commissioner: Note the objection of counsel for defendants.
Received and Marked Complainants' Exhibit No 158.
Marked Complainants' Exhibit No. 158.

Direct examination by Mr. O'Sullivan (resumed):

Q. Mr. Alvord, have you studied the stipulation between the United States Government, the State of New Jersey and the
2732 Passaic Valley Sewerage Commission, being Complainants' Exhibit No. 135 in evidence in this case?
A. I have.
Q. What were the results of your study of that stipulation?
A. It is my judgment from a careful study of the stipulation and a study of the conditions suggested between the Passaic Valley Sewerage Commission and the United States Government that the enforcement of this stipulation, as far as it affects the right and interests of the city of New York, would be impracticable if not impossible by reason of the following difficulties:
1. The interests of the United States and the City of New York are not identical.

Mr. Riker: Questions along these lines are objected to on the ground that the opinions of this witness as to the enforcement of a stipulation on behalf of the City of New York is incompetent, irrelevant and immaterial to this issue, inasmuch as the City of New York is not a party to this litigation, and it presupposes along the lines of his own immediate statement preceding this objection that the State of New Jersey and the Passaic Valley Sewerage Commissioners do not propose to perform the agreement.
The Commissioner: Note the objection of counsel for defendants.

A. (Continuing:) 2. The fact that this stipulation calls for an almost perfect effluent except as to soluble impurities capable of absorbing some dissolved oxygen makes the stipulation in my opinion impracticable. Such results as are called for in this stipulation have never anywhere been attained on such a scale from such a sewage plant or even far more complete plants, so far as my knowledge of sewerage purification goes. It is therefore in my opinion

exceedingly difficult of enforcement because it calls for that which is practically impossible. To illustrate the impracticability of enforcing such a provision, I may say that the Chicago Drainage Canal is at the present time operating illegally but it cannot be stopped from so doing as a matter of public policy. I am of the opinion that once the Passaic Valley Sewer were built and in operation the same result would ensue.

2733 Mr. Riker: I desire to put on the record a notice of motion to strike out the testimony of this witness as to the illegality of the Chicago Drainage Canal, and all other matters that involve determination of illegal consequences, as he is not qualified as a legal expert.

The Commissioner: Note the motion of counsel for defendants.

A. (Continuing:) 3. The City of New York will have no opportunity of inspection as to the working of the plant or opportunity to investigate the character of its effluent until an appreciable interval of time after the said effluent is mixed, at a depth of 40 or 50 feet below the surface, with the waters of the bay.

4. It would be impracticable to identify deposits in New York Bay as comnig from this particular outlet.

5. It would be difficult to determine odors as being specifically due to this outlet, except in the immediate vicinity thereof, and even these odors might be due in part to other and additional pollution.

6. It might, however, be practicable to determine to a limited extent, that suspended matter, grease or color in the waters of New York Bay were due largely to the presence of this outlet, especially in its immediate vicinity.

7. It would be impossible, in my opinion, to trace injury to the public health to this cause alone.

8. It would be impossible to say to what extent the major fish life of the harbor would be injured because of the inability to separate the effects of this specific pollution, from other pollution and because of our lack of knowledge as to what is detrimental to fish life.

9. It is well understood that sewage disposal plants are commonly neglected as to their operation, and their effluents greatly deteriorate under such circumstances, and the City of New York has, in my opinion, no practicable means by which it can enforce proper attention to the necessary operation of this plant.

10. But, even if carefully operated, such a plant as de-
2734 scribed will not, in my opinion, accomplish the results agreed to be accomplished, particularly in No. 2 and No. 4 of the specific performances promised.

Q. Are these proposed sewage disposal works described in Complainants' Exhibit No. 135, adequate or inadequate to purify the sewage proposed to be discharged at the outlet of the trunk sewer at Robbins Reef?

A. It is my conviction, from a study and examination of the Passaic Valley community, that the sewage will arrive at these

works in a state of advanced decomposition; that the solids of fecal matter will be disintegrated so as to easily pass both screens provided; that the liquid will already be black, odorous, laden with finely commutated matter, and with a maximum of impurity in solution. Neither of the screens will therefore, in my opinion, remove more than the floating trash, which always accompanies the flow of large sewers, and which is relatively small in amount. Nor will the tanks receive deposits of more than the coarser and heavier particles during the short check to the velocity of the flowing sewage.

My observations on sewage disposal works have convinced me that it is a prime essential to their success that the sewage be received by them in a comparatively fresh state. When this is the case and with proper design and operation they are uniformly quite successful. When this is not the case they have been locally objectionable and usually inefficient. Where a long intercepting sewer such as here is proposed, some 21 and 2/10 miles in length, must bring the sewage from other systems of sewers, the sewage itself cannot but be in an old decomposed and rotten condition. The solids being finely commutated into suspended matter, which is scarcely visible as well as colloids, which are suspended matter on the verge of translation into impurities in solution. To completely purify such sewage on a large scale successfully is practically impossible at any reasonable cost.

From the testimony given in this case by Mr. Harrison P. Eddy, going into detail as to the length of time taken for the sewage of the various communities to reach the outlet, I note that the
2735 sewage will be from 12 5/10 hours old under the most favorable conditions to 18 or more hours old under the least favorable conditions. This determines that the sewage will be such in character that ordinary or usual works for its purification would need to be tremendously expensive, vastly more expensive than works for the treating of fresh sewage. It also means that works for screening and sedimentation are less efficient than would be the case with fresh sewage. It is also known that old, stale and refractory sewage of this character is more difficult to filter. Experience upon filter beds denote that it is exceedingly difficult in aerobic filtration to nitrify successfully the effluents from tanks in which sewage has remained for very many hours, corresponding with the age denoted herein. I am therefore, of the opinion that such works will have the minimum of efficiency either for removing suspended matters or for screening them. A certain amount of trash will undoubtedly be removed by the coarser screenings, but the finer suspended matters will readily pass through the screens called for by this agreement.

Q. Will you state what experience you have had in the observation of the discharge of large quantities of sewage into bodies of water such as that of New York Upper Bay and give the results of your experience in that respect?

A. For many years prior to the completion of the Drainage Channel in the Sanitary District of Chicago, it was the custom to discharge some of the sewage of Chicago directly into Lake Michigan

from certain sewers of the city. Observation of such discharge covering a good many years convinces me that such sewage rises to the surface rapidly by reason of its temperature and consequent less specific gravity; that it there spreads out over distinct fields or tracts which do not rapidly mix with the colder waters *in* which it comes into contact. In this condition it is usually removed by the winds in long lanes which are visible at times for many miles, and which preserve their identity at times for considerable periods.

I had occasion in October, 1911, to visit the Moon Island
2736 Sewer Outlet at Boston, as well as the Nutt Island Sewer Outlet. At Nutt Island I observed the sewage of about 400,000 population amounting to about 40,000,000 gallons a day, discharged through a submerged outlet about 30 feet below the surface of the water at low tide. The water was observed to boil up at the outlet, distinctly visible from where I stood near the screening house, probably a mile distant. It spread out into a lake which I judged might be a mile in length and perhaps one-quarter to three-eighths of a mile in width. The limits of this field of sewage were traceable from the purer sea water and a number of flocks of gulls were observed over its surface feeding upon the organic matters evidently floating there. At the Moon Island Outlet which I visited the same day, the discharge had just been completed from the tank and the sewage covered a field which was extended as far as I could see and was perhaps one-half mile in width. The color of this field of sewage was discernible, differing as it would along its margin from the waters of the bay and here as at Nutt Island flocks of gulls were feeding upon the organic matters of the sewage.

In 1898 it was my privilege to study the sewage disposal of Columbus, Ohio, which then had a long intercepting sewer carrying sewage a considerable distance below the city and leaving it in an old, stale and decomposable condition. It was impressed upon me at that time, as it has been since, what a vast difference there is between purifying a stale and septic sewage and one which is comparatively fresh. Most of the difficulties which arise in purification works are traceable to this cause and would be obviated were it possible to receive the sewage within three or four hours of its creation. The intercepting sewer at Milwaukee delivers about 30,000,000 gallons of sewage into Milwaukee Bay. It has been my privilege to study the sewage purification problem of Milwaukee during the last three years, and frequently I have visited these works and observed the action of the sewage which is delivered into the bay in a foul, black and decomposed condition. This
2737 sewage seldom is evenly diffused into the water of the bay.

It is my impression, therefore, as the result of the experiences above related that the sewage will gradually rise from the proposed submerged outlets at Robbins Reef to the surface of the bay, due both to the fact that its lighter specific gravity, particularly in saline waters, and also to the higher temperature of the sewage outflow undergoing as it is chemical change of the matter. As it reaches the surface it will widen out in a surface field which will take the direction of the tide, aided or retarded by the prevailing

wind of the time. In this state it will be carried well up the Hudson and East Rivers on the flood tide and out of the Narrows on the ebb.

The dispersion of sewage flow in large bodies of water with considerable currents induced either by the wind as in Lake Michigan or by the tide as in Boston Harbor, is, as far as my experience goes, analogous to the form that smoke ordinarily takes in issuing from a chimney; that is, there is not great diffusion even at very considerable distances from the outlet, unless wind currents are absent. This has been particularly observed by the sanitary survey of the southern end of Lake Michigan in 1909 by Messrs. Bernard and Brewster, chemists and bacteriologists of the Indiana State Board of Health. Their bacterial examinations of lake water made in direct lines from the shore clearly show several such streams of sewage which originate from large sewers at the shore, traceable for great distances in some cases as much as five miles from their source. These determinations made by counting the bacteria from samples collected, were much more acute than ordinary observations by eye. Distinct boundaries to the sewage fields were crossed in which bacterial counts rose and fell in most marked manner.

If the above conclusions are sound, and I believe they are, we will have before the completion of the Passaic Valley Sewer in or about 1918, from this outlet alone, over 360 acres one foot deep of sewage per day and by 1940 over 1100 acres one foot deep of
2738 Sewage per day to flow away from this outlet in a visible field or stream of black, unsightly polluted water, disfiguring the surface of the Upper Bay, and with favoring wind and tide conditions reaching well into the Hudson and East Rivers at flood tide; while under other conditions there will be wider dispersion, odors and visible floating matters of a more finely divided character, but in all cases serious reduction in dissolved oxygen.

Q. Mr. Alvord, are there any other and better means that can be adopted by the communities of the Passaic Valley for disposing of their sewage other than that proposed through the trunk sewer project?

A. Yes, sir. I have reviewed the various reports which have been made to the communities in the Passaic Valley as to the practicability of purifying their own sewage. Some of these reports are quite important. Mr. Allan Hazen, Civil Engineer, in 1905 made an exhaustive investigation as to the cost of purifying the sewage of Paterson and compared it with the cost of the trunk sewer project. Mr. Fuertes, Civil Engineer, has also reported in detail on the sewage disposal of Orange, Montclair and East Orange, New Jersey, on October 14, 1911, and in 1910 Mr. Harrison P. Eddy, Consulting Engineer, reported upon the disposal of sewage at East Orange, Montclair, Bloomfield and Glen Ridge.

I have also investigated to some extent the practicability of these various projects and compared their cost with costs of other works with which I am familiar and with practical experience which I have had. Without going into too much detail in each case, I would say that my general conclusion is that the sewage of these

population centers either singly or in groups can be more efficiently purified than is proposed by the Passaic Valley Sewerage Commission upon sites reasonably near the corporate boundaries so that the sewage may be treated while it is still fresh, and I would conclude that the first cost of intercepting sewers, pumping stations and sewage disposal plants will range from thirteen to sixteen dollars per capita, with an average probably of fourteen dollars per capita.

2739 I would also conclude from these reports and from such other reports as I am familiar with on projects of a similar character, as well as from my own practical experience, that including interest and depreciation, it would cost to operate such plants from 90 cents per capita per annum to $1.30 per capita per annum, with an average probably of $1.10 per capita per annum.

I also conclude that the trunk sewer as proposed with the partial purification works at its outfall will cost to build, administer, supervise and maintain, including interest and depreciation, the sum of about $1.00 per capita per annum. If more adequate purification should be necessarily installed in the future such as that herein estimated upon for other communities, I should estimate that the cost would become $1.50 or $1.60 per capita per annum. It will, therefore, be seen from these conclusions that the cost of purifying the sewage for each of these communities or group of communities independently will exceed the cost of the trunk sewer project per annum by only about 10 cents, while if more complete sewage purification is necessary to the trunk sewer, as in my opinion will be the case, the cost per capita of the trunk sewer with such purification will be materially greater than independent purification plants. In this comparison there is not included, however, certain important and salient facts which should be taken into consideration in making a decision and which cannot be expressed in mere figures alone.

First. Successful sewage purification, wherever I have observed it, has only been accomplished where fresh sewage is treated by purification plants which are located so close to the origin of the sewage that at least not more than 4 to 6 hours transit may intervene. The importance of this statement cannot be overestimated, and of itself alone, in my opinion, would justify the adoption, of this plan as against any plan which must involve a long interception sewer whereby the age of the sewage will become more than 12 or 15 hours.

2740 Second. Of all the different problems of which I am aware that of satisfactorily treating old, stale, decomposed sewage which has been in transit from its point of origin to the outfall more than eight or ten hours is probably the most difficult and the most complicated. While it is theoretically possible to accomplish such purification, it is not in my opinion practically possible because it cannot be accomplished at any reasonable expense. Nor in my opinion is it accomplished in any event without the accompaniment of obnoxious odors and offensive conditions to the surrounding environment. In saying this I do not entirely exclude dilution as a final stage of purification.

Q. Mr. Alvord, have you seen Complainants' Exhibit Nos. 1 to 126, have they been submitted to you?

A. Yes, sir.

Q. Have you read the hypothetical question put to Mr. Harrison P. Eddy in this case?

A. Yes.

Q. Now, Mr. Alvord, taking all these facts and circumstances of record in this case, and facts observed by you, into your full consideration, what in your opinion will be the result of the contemplated discharge from the Passaic Valley Trunk Sewer outlet into Upper New York Bay in the vicinity of Robbins Reef on the harbor waters and tidal waters of New York Harbor, under present existing conditions, and under prospective conditions on or about the year 1940, and during the intervening period between the present year 1912 and the year 1940?

Mr. Rker: The question is objected to on the same ground stated in my objection upon the hypothetical question in the same form to the last witness to whom it was addressed.

The Commissioner: Note the objection of counsel for defendants.

A. There will be times when the digestive capacity of the harbor waters of the city will be seriously reduced by the proposed diversion from its natural course of the sewage of the Passaic Valley and serious nuisance will be caused by such diversion. In coming to this conclusion I have carefully considered the following summarized data of the evidence in this case:

2741 Dissolved Oxygen.—The waters of the Upper Bay at the present time are heavily charged with sewage. They contain on ebb tide about 65 per cent. and on the average of ebb and flood tides about 71 per cent. of the amount of disolved oxygen necessary saturation. As further shown by the testimony of Mr. H. de B. Parsons, the new sea and land water- in the Upper Bay available for the dilution of the sewage are as follows:

In Million Cubic Feet per Tidal Cycle.

	New Sea-water.	New Land-water.	Total.
Average for year	2210	1.180	3390
Least amount, February	670	690	1360
Least amount, August	1520	620	2140

Also, from Mr. H. de B. Parsons' testimony we find that if the quantity of water available for dilution is taken as the resultant flow through the Narrows, then the quantities in million cubic feet tidal cycle will become as follows:

Average for year	(29,200 c. f. s.)	1260
Least amount, February	(17,800 c. f. s.)	770
Least amount, August	(16,200 c. f. s.)	700

I further observe from the testimony of Mr. Harrison P. Eddy that the average percentage of oxygen saturation at the mouth of the

Hudson River, near Pier A, is only 55 per cent.; while the East River at the same locality is only 54 per cent.; and, at the same time, the average determination of samples at the mouth of Newark Bay is 64 per cent. of complete saturation, thus showing fairly well that the effluent from the present Passaic River purified as it is by sedimentation and septic action in the river and tidal action in Newark Bay, is more clean evidently than the waters of the Hudson or the East River, near the Battery. Further, the oxygen saturation near Robbins Reef Light is but 72 per cent. at times, and 79 per cent. at the Narrows on the average. It may be properly said, therefore, that the purified waters of the Passaic River at the foot of Newark Bay are now cleaner than the waters of the New York Upper
2742 Bay into which the sewage of the Passaic Valley is proposed to be directly emptied.

By transferring, therefore, the raw sewage directly to the center of the New York Bay all of this advantageous condition, so far as New York Bay is concerned, is to be lost.

Float Experiments.—A study of float experiments as placed in evidence herein shows that a particle set adrift off Robbins Reef in the main channel on flood tide would take four tidal cycles to remain outside of Sandy Hook—about 50 hours—and if started on ebb tide would take three tidal cycles—about 38 hours. It would take two tidal cycles for the particle to remain outside of the Narrows if started on flood and one cycle if started on ebb. All these estimates are based on the assumption that the particle will remain in the seaward trend of the current and not get delayed by cross-currents.

It would appear therefore that the Upper New York Bay so far as new water is concerned, and so far as discharge is concerned, is not in any true sense an estuary such as are discussed so fully in English practice, but more in the nature of an enclosed and throttled brackish lake into which some small interchange of fresh land and sea water is gradually introduced, but in which the same water becoming polluted as it does fluctuates backward and forward many times. Notably is this true in the East River. Therefore, we cannot count on having fresh land or sea water added at each tide, except to the degree of about 23 per cent., if Mr. H. de B. Parsons' analysis is correct, and I believe it is.

The digestive capacity of waters *are* measured by the oxygen content available and by the plankton that aid in the disintegration of organic matter. The waters of the Upper Bay of New York are brackish waters. It is believed by some authorities that the sea plankton are largely destroyed by this admixture of fresh water and the fresh water plankton die and are deposited in the presence of salt water. It is now thought therefore, that the digestive capacity of brackish waters is greatly inferior to the digestive capacity either of fresh or saline water, unmixed, and chiefly on ac-
2743 count of this destruction of both marine and fresh water plankton.

It is to be observed that sea water has less capacity for absorbing oxygen than has fresh water, and that most of our data on dilution

are obtained in fresh water streams. It may be observed that at a temperature of 78 degrees Fahrenheit that fresh water can absorb 22 per cent. more oxygen than sea water. This point is an important one to bear in mind when considering the ordinary data of fresh water dilution ratios.

It appears to me from such studies as I have made of the investigations of the Royal Sewerage Commission of England and from the testimony in this case, and from such other data and practical experience as I have had that while we are not yet justified in fixing definite limits in terms of dissolved oxygen for the existence of major fish life, yet in saline waters such data as we have points, in my opinion, to a value of 40 to 50 per cent. of saturation as being the least amount of oxygen which should be allowed to exist at the critical point of contact between incoming filth and naturally clean water. This will mean an average of probably over 60 or 70 per cent. for such general conditions as exist in the upper harbor of New York.

It would also appear to me that the discharge of further large amounts of sewage into the waters of the Upper Bay and New York Harbor, already seriously laden with organic matter, will not only directly reduce the specific oxygen content of that locality, but also indirectly seriously deplete the digestive ability of large fields or areas of water now at the verge of insufficiency in oxygen, thus seriously increasing the nuisances already existing at certain points of the waterfront, as well as creating in and about the harbor new and serious areas of offensive pollution.

It is my belief that it is impracticable, as pointed out by Mr. Fitzgerald's testimony in this case, to complete the works of the Passaic Valley Sewerage Commission before about 1918 or five years from this time, by which time the population of the Metropolitan District will have increased to about 7,600,000 people and
2744 the total sewage flow about 1,000,000,000 gallons daily, or in other words twice the sewage flow which occasioned the city and state of New York to investigate the pollution of the harbor.

The Passaic River and the Newark Bay now constitute what might be well called a natural sewage disposal plant by sedimentation, septic action and tidal dilution, and while this natural plant is locally obnoxious its results as shown by the dissolved oxygen content at the lower end of Newark Bay are more effective, as has been said before, than the purification caused by the dilution of the waters of the Hudson River and the tidal action off the Battery in New York City upon New York City sewage. No problem of this character was ever in my opinion finally solved by transferring it out of its natural drainage district into the drainage district of another community, where natural conditions were already insufficient to care for the increasing pollution there existing.

The presence of large sludge deposits is now considered to be greatly deterimental to the digestive capacity of harbor waters. Not only by depletion of the dissolved oxygen, but according to the researches of Adeney, also by denitrifying the nitrogen, thus making

it necessary that much of the work of purification be done over again.

In the Chicago Drainage Channel the two million or more cubic yards of sludge known to have been deposited since the channel was opened in 1900, together with the deposits formed in the connecting branches of the Chicago River is believed by those who have studied the question, to have a most serious deterrent effect upon the digestive capacity of the diluting water from Lake Michigan.

Our ideas of the efficiency of dilution are in a transition stage. Much of the data on the subject are yet being studied. Earlier ideas based upon the efficiency of running water of inland streams for purification are not applicable to the complex environment of New York Harbor and indeed are not always applicable to uniform flows of fresh water where large amounts of trade waste are involved.

Thus the city of Chicago, having expended over sixty mil-
2745 lions of dollars, about $25.00 per capita, to build a drainage channel on scientific lines, under expert advice, has found that it must revise the fundamental data of dilution ratios upon which the design was made. The drainage Channel of Chicago, only ten years after its completion, is now openly admitted to be insufficient capacity; *and* is clearly shown by the recent able report of its present chief engineer, Mr. George Wisner.

It may be pointed out that the money expended for this channel is perhaps fully twice the amount per capita necessary to provide intercepting sewers, pumping stations, sewage purification plants for the sewage of the entire population of the city of Chicago.

Q. From all these studies and matters also that you have taken into your consideration, what would you expect to be the result of the discharge of the Passaic Valley sewage through the Passaic Valley Trunk Sewer at the outfall at Robbins Reef?

Mr. Riker: The same objection to this question as to the last hypothetical question.

The Commissioner: Note the objection of counsel for defendants.

A. I would expect that it would have a serious effect in abstracting further the oxygen from the waters of New York Harbor. Experience has shown that where waters are nearly laden up to their limits, slight additions become apparent in the most unexpected manner. Thus, the channel of the Chicago Drainage Canal was practically inoffensive for eight or nine years, but the last increment of pollution caused it to become immensely disagreeable. I would expect to see visible floating matter, sleek, greasy colored fields, apparently well defined under some conditions from this outlet, and more diffused under other conditions, and I would expect that there would be nuisances increasing with the population under such conditions.

2746 Q. Is the transition stage from a condition that is tolerable in sewage laden waters to one that is unbearable sudden, or slow?

A. So far as my experience goes it is comparatively sudden. There is a long period preparatory in which the collection of sludge on the bottom, in which the growth of slight discoloration is not usually found unbearable, but there comes a time when the last in-

crement of polluting matter is added which the waters will digest and immediately at that time there flashes up a condition of odor and nuisance and other intolerable conditions which cause the nuisance to become unbearable.

Q. From your familiarity with the waters of New York Harbor, and particularly the waters of New York Upper Bay, do you think that there is a large or a small margin of digestive capacity left for the riparian communities as to sewage digestion?

Mr. Riker: The question is objected to as immaterial, irrelevant and incompetent. It is not a question in this case of the rights of riparian communities at all; it is a question of the rights of sovereign states that are concerned in this investigaton

The Commissioner: Note the objection of counsel for defendants.

A. It is my opinion that the margin left is now exceedingly small.

Cross-examination by Mr. Riker:

Q. Do you object to giving your age?

A. Age fifty-one years.

Q. Is there any fact in your experience which was left out of your qualifications which you would like to put in?

A. No, sir, nothing in particular.

Q. Because if there is I wish to give you an opportunity on cross-examination—there is nothing that you think of?

A. I have already said so.

Q. Your evidence you have put in written form. You have your evidence, that you have given by reading from a statement, have you not, for the most part?

A. The greater portion of it has been.

Q. And that has been prepared with a good deal of care?

A. Yes, sir.

2747 Q. Covering how long a period have you been working upon this evidence you have given, reading from a written statement?

A. The period has covered nine or ten months.

Q. And how does your testimony that you have read differ from Complainants Exhibit No. 158, which you have not read. Is there anything in this that is materially different from your testimony which you have given orally from your memorandum?

A. I think it is. The two do not cover the same field at all.

Q. Do not cover the same field?

A. No sir.

Q. In no respect?

A. Not that I recall.

Q. What is "commutated matter". I think you used that expression. What do you mean by commutated matter?

A. Commutated matter, as used in the art of sewage purification, is finely divided suspended matters. The reduction of the larger solids in the harbor causes them to disintegrate into smaller and smaller particles.

Q. Does it differ at all from comminuted?
A. Comminuted is the word I expect I have used.
Q. You used the word commutated?
A. Then it was a mistake.
Q. You meant comminuted?
A. Comminuted is the word I supposed I used.
Q. Do you wish to have it changed if that is the word you used?
A. I do not think I spoke of any other word.
Q. If you did use commutated, do you desire to have it changed or not?
A. It may be changed if I used it.
Q. Has it any meaning at all in connection with sewage matters, if you did use it, commutated?
A. It has not. The word which I supposed I was using was "comminuted." It was an accidental slip of the tongue entirely.
Q. You had it written, did you not?
A. I must have mispronounced it, if I said what you say I did.
Q. You testified to having examined the East Orange disposal works at some time. When did you examine it?
A. It was in the year 1888.
2743 Q. And I think you said that had been abandoned?
A. Yes, sir.
Q. Do you know why?
A. I was informed at the time but I do not know that I now fully recall. My general impression is that it was outgrown.
Q. That is your impression?
A. Yes.
Q. It is not your impression that it constituted a nuisance and was removed for that reason?
A. No, there was nothing said about its being a nuisance. It was a chemical precipitation plant.
Q. You made some tours in inspection of the harbor of New York, did you not, in 1911?
A. Yes sir.
Q. Where did the pollution that you observed during those tours of inspection come from, so far as territory is concerned?
A. I inspected the sewers of Manhattan and the Passaic Valley and the sewage came from the City of New York or the Borough of New York, the Borough of Brooklyn, the City of Newark, the City of Paterson, Passaic, and other smaller communities in that vicinity.
Q. Confining your testimony now to the Bay of New York, where did the sewage pollution come from that you observed?
A. It came more largely from the Borough of New York and Brooklyn, although some of it may have come from the State of New Jersey.
Q. Did you observe any pollution of the waters of the Bay of New York from the territory of the State of New Jersey?
A. I was not able to determine that I observed any. I was not able to determine if that, all of it, came from the Boroughs of New York and Brooklyn.

Q. Did you observe any of it coming from the Boroughs of New York and Brooklyn?

A. I did.

Q. You say you have studied the stipulation between the United States, the State of New Jersey and the Passaic Valley Sewerage Commission. When did you make that study?

A. I have had it under consideration at various times for eight or nine months.

Q. Now, directing your attention specifically to the processes and apparatus described as part of the plant to be established by the Passaic Valley Sewerage Commissioners for the purification
2749 of the sewage of the district, where, in your experience or observation, have you ever seen a plant of as great efficiency devoted to the purification of sewage which is to be discharged into harbor waters?

A. I never have seen one of as great efficiency proposed or in operation.

Q. Have you ever seen the effluent from a plant as described in this stipulation discharged into harbor water?

A. I have in smaller plants.

Q. Under conditions as described in this stipulation, so far as discharge is concerned, have you ever seen that?

A. No sir.

Q. How do you undertake then to say what the result of that discharge will be from such a plant as is described in the stipulation?

A. Because I have had a good deal of experience on each phase of the question you are seeking an answer to. I have, for instance, observed the discharge of sewage from submerged outlets.

Q. Where?

A. In many cases in Chicago for many years. I have built submerged outlets, the operation of which I have watched with considerable interest. I have observed the effluents from large sedimentation tanks built along the shore of Lake Michigan into submerged outlets. I have observed the effluent from very large plants, such as the London chemical precipitation tanks, and from more complete plants, such as Manchester and Birmingham in England, Columbus, Ohio, in this country, Worcester, Massachusetts, and other places, and my conclusion, while not based on the observation of a plant precisely of this size and precisely of its character, and precisely of the quantity with which it deals, is nevertheless, to my mind, valuable, because of the various phases of the same proposition which it has been my privilege to observe.

Q. Where have you seen an effluent discharging at a depth of 40 feet into a channel of a harbor of the character of New York?

A. I have not seen any submerged outlet of precisely that depth but I have seen, as I have already stated, the discharge of the Nutt Island outlet in the harbor of Boston, which is perhaps the nearest approach to that condition.

2750 Q. How does that discharge at Nutt Island operate, vertically, horizontally, or in what way?

A. It discharges vertically.
Q. Through one outlet, or through many?
A. Through two outlets.
Q. Of what size?
A. My impression is there are two pipes five feet in diameter, with a tee on the end of each, turning upwards, so that the discharge is delivered in a vertical direction.
Q. Is that sewage at Nutt Island treated in any way?
A. It is screened.
Q. What kind of screening?
A. There is a cage which has bars on it, which detains the floating trash of large size, and which is periodically lifted and trash removed.
Q. Any more treatment?
A. None other that I know of.
Q. What is the population served by that outlet?
A. My information is that there are about 400,000 people, are taken care of at this time.
Q. Have you any other knowledge of the Passaic Valley Sewerage Commissioners' plans beyond what you have testified to in your direct examination?
A. I have seen a set of the detailed plans, or what purport to be the detailed plans, a reproduction of the detailed plans of the Sewerage Commissioners.
Q. When did you see that?
A. I saw that last week.
Q. Did you ascertain whether or not the plans had been reduced to any definiteness by a contract for the construction of the sewer by the commissioners on behalf of any of the municipalities in the Passaic Valley Sewerage District?
A. Only to the extent that the plans appeared to be working and fairly detailed plans. I saw no evidence that they had been placed under contract.
Q. Where did you see them?
A. In the office of Doctor O'Sullivan, the Assistant Corporation Counsel's Office.
Q. And you had no other verification of this as to the plans that were contemplated at the present time?
A. No sir. There was every internal evidence that they were what they purported to be.
Q. Do you know the population at the last Federal census in 1910 of the municipalities which have actually contracted
2751 with the Passaic Valley Sewerage Commissioners for the construction of a joint outlet sewer?
A. I do not recall the precise figures at this time. They have passed under my eye several times, but I have not retained them.
Q. Do you know what municipalities have in fact contracted for the construction of a sewer?
A. In a general way only.
Q. Well, in a general way only, can you state in an offhand way

then what your idea of that population is as shown by the last census?

A. In a general way I have in mind that Passaic, Paterson and Newark and quite a number of the smaller communities in between have agreed to the construction of this trunk sewer, but that certain communities known, I think, as upland communities, like Montclair, Orange and East Orange, have not, as I understand it, agreed to come into the general arrangement. I am unable to give you the precise population.

Q. In a general way is all I ask you for, as near as you gave for the population served by the Nutt Island outlet?

A. Well, I have here the Passaic Valley Sewerage Commissioners' estimate of their population for 1911 at 702,400 persons.

Q. When was that estimate made?

A. That was put in evidence by Mr. Harrison P. Eddy.

Q. Do you know when it was made?

A. No sir.

Q. Of your own knowledge you do not know anything about it?

A. No sir.

Q. How old is the sewage discharged at the Nutt Island outlet when it is discharged?

A. Well, I imagine it is as old as the sewage from the Passaic Valley, about 14 to 18 hours old.

Q. When you speak of that age of the Passaic Valley sewage, at what point do you calculate its age?

A. I calculate its age as to the longest run of the sewage, as we always recognize the fact that sewage rapidly infects incoming sewage, thus increasing its apparent age.

A. At what point do you calculate that as 14 to 18 hours?

A. From the outlying district of Paterson to the outlet at Robbins Reef.

2752 Q. Not to the purification plant?

A. No, sir.

Q. Now, what will be the age, in your judgment, of the sewage that will be discharged at the purification plant?

A. Perhaps 11 to 14 hours.

Q. Why do you make any limits of 11 to 14 hours. Cannot you state the age taking your theory into account, that is, the longest lateral line that should be taken as determining the age of the sewage?

A. No, sir.

Q. Why cannot you?

A. Because the conditions are very variable. They vary as the hours of the day go by; they vary as the season goes by, they vary as the years go by, and there are maximum and minimum quantities flowing, and with the maximum quantities the age will lessen, because the velocity will increase. With minimum quantities the age will increase, because the velocity will lessen.

Q. What you mean by that is that the velocity at the extreme end of the longest lateral will increase at the sewage disposal plant, do you?

A. The velocity at the extreme end of the longest lateral will not be so greatly variable, but generally speaking the velocity through the sub-main sewer, and the main sewers in each of the municipalities and the intercepting sewer, will vary from time to time under various conditions.

Q. As much as from 11 to 14 hours at the disposal plant, in your opinion?

A. Yes.

Q. You have given consideration to it, have estimated it?

A. In a general way. I have, however, taking the detailed figures largely from analyses made by Harrison P. Eddy in this case.

Q. In what municipalities is the proposed disposal plant located?

A. Well, I am not informed. If in any municipality, I should judge it was probably the City of Newark. I have no exact knowledge of the legal corporate boundaries of the City of Newark, but I should imagine that it was within the City of Newark if in any.

Q. Have you inspected the proposed location of the proposed purification plant?

A. Yes, sir.

2753 Q. You know where that is?

A. Yes, sir.

Q. Now, you know where it is with reference to the City of Newark?

A. Yes, sir.

Q. From your study of the conditions in the Passaic Valley, upon which you base your professional advice to those municipalities to establish separate plants, can you point out a more appropriate place for the sewage of the City of Newark than the proposal plant proposed to be located by the Passaic Valley Sewerage Commissioners?

A. Well, my study has not disclosed one for the City of Newark alone more appropriate than that one. There may be other locations which are more available and perhaps more appropriate, and which a thorough study might disclose.

Q. You are guessing as to that I suppose, are you not?

A. My knowledge as to other locations, other than the one you mention is not complete.

Q. And your professional advice to the City of Newark is not ready to be administered to them yet without further study I suppose, is it?

A. I am not aware that I am offering any professional advice to the City of Newark. I am, if I may be pardoned for saying so, giving only an opinion in this case.

Q. Under retainer from the complainants?

A. I am receiving a retainer from the complainants.

Q. Well, you remember testifying on your direct as to more appropriate methods of disposing of the sewage of the Passaic Valley, do you not?

A. Yes, sir.

Q. And you remember testifying that separate plants for these different municipalities, in your opinion, was the more appropriate way?

A. Yes, sir.

Q. What will be the age of the sewage of the City of Newark when delivered to a disposal plant such as you recommend to be established for that city?

A. The sewage of the City of Newark alone delivered to the site under consideration would be comparatively fresh, perhaps not entirely so, but in much better condition, in my opinion to purify than if commingled with the sewage of the localities on the
2754 river above it.

Q. Well, what would be the limits of age of the sewage of Newark when delivered to a disposal plant such as you would select, if you have estimated?

A. Well, I would endeavor to select a location that would make that age as small as possible.

Q. And would you locate that plant with any regard to the cost of the property upon which it is to be located?

A. Most assuredly.

Q. And the surroundings?

A. Most assuredly.

Q. You would not place it within the built up section of the City of Newark?

A. No, sir.

Q. You are somewhat familiar with the surroundings of the City of Newark?

A. To a degree.

Q. Do you know of any place that is available nearer than the proposed site of the disposal plant of the Passaic Valley Sewerage Commissioners?

A. I am under the impression that it might be placed nearer the city than that site without at the same time being located on land which was built up, highly expensive, land to be used for residential purposes.

Q. How much nearer?

A. Well, I would be unable to say now without examining the map and looking into it more closely. I speak of that only as a general impression.

Q. Assuming, Mr. Alvord, that the sewage disposal plant for the City of Newark is located at the point selected by the commissioners, as you understand it, what would be the age of the City of Newark sewage when discharged into that purifying plant?

A. Well, to make a very approximate answer to your question, not based on any close analysis, it might be from 4 to 7 hours old.

Q. And you think that the age of the sewage of the other municipalities in the Passaic Valley when delivered at the city line of the City of Newark, will be 8 or 10 hours old by any possibility?

A. Yes, sir.

Q. What do you base that upon? What are the facts within your own knowledge that you base it on?

A. It is impossible to subtract one sewage from the gen-
2755 eral bulk of sewage, and then predicate an estimate of the age of the rest of the sewage, because as I have remarked the

older sewage also always infects the fresher or newer sewage, and infects it with its general characteristics as to age very readily.

Q. Well, probably I do not make myself clear. What in your judgment will be the age of the sewage from the municipalities lying above the City of Newark, if discharged through the proposed outlet sewer at the line of the city of Newark?

A. I am unable to say without referring to the tabular analysis.

Q. And in this part of your testimony you are relying on what, your own observations or the statements of others?

A. A general conclusion which I have formed from the case as a whole and predicated more particularly on the detailed analysis put in evidence by Mr. Harrison P. Eddy.

Q. And from that detailed evidence put in by Mr. Eddy you cannot give the age of the sewage when it shall have reached the upper boundary line of the City of Newark through the proposed Passaic Valley Sewer?

A. I would not like to do so without a more careful examination of that detailed analysis.

Q. Do you know what the size of the City of Manchester, England, is?

A. I am not informed as to its population at the present time. At the time I visited the plant there it was much smaller than it is at the present time, and the population was not a very good guide to the size of the city, because the corporate limits do not include a considerable amount of populated area adjacent.

Q. How much population did the disposal plant there serve when you saw it?

A. I am unable to say.

Q. No estimate at all?

A. Well, the population, as I recall it, was something like 500,000 people. My impression is that the sewage probably would be equivalent to about that amount, because other boroughs than Manchester itself were included in the general scheme.

Q. Where was the plant located with reference to the city when you saw it?

A. Below the city.

2756 Q. How far?

A. I do not recall.

Q. Cannot you give an estimate?

A. No, sir.

Q. You have no recollection at all about that?

A. No, sir, I cannot at this time.

Q. Was it a mile?

A. My visit was in 1888, and the present works at Manchester, which you are perhaps alluding to, were not then built.

Q. I am asking you now about the works that you saw; how far were they located from the city?

A. I could not state.

Q. Not within a mile?

A. Why, we traveled a considerable distance, I should judge about an hour from the city.

Q. By what conveyance?

A. We went by carriage.

Q. How old was the sewage when delivered at the sewage disposal plant when you saw it?

A. Well, it was apparently very foul, but that may have been due largely to its concentrated character. English sewage is much more concentrated than American sewage, therefore it has the appearance of foulness to a greater degree at certain ages than American sewage.

Q. You did not calculate the age of the sewage?

A. I do not recall that I did at that time, no sir.

Q. Where is the present plant located with reference to the City of Manchester, if you know?

A. I do not know. I have never visited the present plant.

Q. Well, you have read scientific works, have you not, on sewage?

A. Yes.

Q. And have you never read anything connected with the present plant?

A. Yes, sir.

Q. Don't you know where it is located with reference to the City of Manchester?

A. I do not recall at this moment. Probably I would recall if I refreshed my mind on it.

Q. Do you know whether it is nearer or further away than the one which you saw?

A. I do not know that.

Q. Do you know the age of the sewage as delivered at the present plant?

A. No, sir.

2757 Q. Do you know what the present plant is as to type?

A. Yes, sir.

Q. What is it?

A. As I recall it it consists of tanks, septic tanks, sprinkling filters, sludge beds, and a certain amount of land disposal, largely for sludge, and there is also some variety of tankage which I am now unable to recall.

Q. Do you know whether the sewage as delivered at the Manchester plant is or is not as old as you have estimated the age of the sewage when delivered at the Passaic Valley Sewerage Commissioners' disposal plant?

A. No, sir; I could not state that at this time.

Q. Where is the effluent from the Manchester works discharged?

A. My impression is that it is discharged into Manchester Ship Canal, although I may be mistaken about that. I have that strong impression, however.

Q. Is that a tidal body of water?

A. No, sir.

Q. And do you know whether that body of water runs through settled country or not; have you ever been over it?

A. I have been on portions of it, yes, sir.

Q. Is it settled, inhabited country that it runs through?

A. It is inhabited in the sense of having villages and an agricultural population, and one or two towns upon it and along it.

Q. From what you know of the character of the Manchester works, in your opinion is the effluent from that as objectionable as would be the effluent from the works as described in the stipulation being Complainants' Exhibit No. 135 in this cause?

A. I have never seen the effluent from the present Manchester works. I have read detailed descriptions of its stability and character, and it is my general impression that it is not as completely purified as might be desirable, considering the canal waters into which it must necessarily empty. I recall that the stability rises occasionally well above the desirable limit.

Q. I ask you to compare it with the effluent which might be expected from the works described in the stipulation between the United States and the State of New Jersey, being Complainants' Exhibit No. 135?

2758 A. My impression is that it is a good deal better effluent, taking it as a whole, over periods of time, than will be discharged from the works of the Passaic Valley Sewerage purification commission and that for the reason that it has passed through a purification stage by oxidation artificially accomplished within the plant itself, which stage is lacking in the works of the Passaic Valley Sewage Commissioners' plant.

Q. What objection, in your opinion, would there be to discharging an equivalent effluent from the Passaic Valley Sewer into the waters of New York Bay?

A. I am not willing to predicate an opinion in the way the question is asked, because I am not familiar enough with the effluent from the Manchester plant, but I am willing to venture the general opinion that the effluent from a plant similarly designed, and carefully designed and properly operated, fitted to the conditions of the Passaic Valey, could not be objectionable in the waters of New York Harbor.

Q. So far as you are acquainted with the devices and processes and appliances in use at Manchester, are you of the opinion that those things would be sufficient to produce an effluent of the character which you have referred to?

A. Properly proportioned I think they would be satisfactory, at least, for many years.

Q. Do you think that the operation of such a plant would be financially prohibitive to the Passaic Valley communities?

A. I think it would be in comparison with plants taking sewage in a new fresh condition nearer the place of origin. That it would be vastly more expensive, because by proper proportioning I had reference to the extension of the oxidizing stage, to the extent of freeing the effluent to that degree, which we know is compatible with the use of such means.

Q. Well, is or is it not your understanding of the Manchester plant that it does dispose of sewage considerably decomposed?

A. At times the stability rises higher than is desirable, so I understand.

Q. And it is a more concentrated sewage, as you understand it, than the sewage which might be anticipated from the Pas-
2759 saic Valley Sewerage District, is it not?

A. Are you referring now to the effluent?

Q. I am referring now to the sewage before it is treated.

A. The Manchester sewage is a more concentrated sewage than will probably be found in the Passaic Valley Sewer.

Q. And is it or is it not, in your opinion, volume for volume, more difficult to treat and purify?

A. To some extent it is; yes, sir.

Q. So that when you said in your direct examination that the production of an effluent which would be unobjectionable within the waters of the bay of New York would be financially prohibitive, you meant only relatively, did you not?

A. Naturally. I qualified the statement, at any reasonable cost. I naturally inferred that there are other methods which should be taken into consideration before expending such large amounts.

Q. That extravagant cost for such treatment as we are now discussing at the proposed works of the Passaic Valley Sewerage Commissioners would be vastly greater than the treatment given to the Manchester sewage?

A. I am unwilling, as I said before, to make comparison with the Manchester sewage in the absence of direct knowledge of the sewage of the new plant, but speaking in a general way I believe that the cost of treating the sewage of the age such as I believe will be reached by the Passaic Valley sewage is very much greater than treating the same sewage within a reasonable distance from the point where it is created.

Q. But are you willing from what you know with reference to the Manchester disposal plant to say that the cost of treatment at that plant is less than will be the cost of the treatment of a similar degree of efficiency at the works proposed by the Passaic Valley Sewerage Commissioners?

A. I cannot answer that, because I have not refreshed myself recently with the figures of the cost of the Manchester plant, and in any event I would regard that as not comparable to American conditions, and to be used with great caution.

Q. Do you think that what is not financially prohibitive in the case of Manchester would be financially prohibitive to the
2760 Passaic Valley Sewerage District?

A. Yes, sir.

Q. Why?

A. Because Manchester had but one alternative, that was to do the thing which she has done. The Passaic Valley has a number of alternative sites for plants, by which she can greatly decrease the cost of her purification, and greatly improve at the same time the character of the purified sewage. Therefore, what would not be prohibitive for Manchester would be prohibitive at any reasonable cost for the Passaic Valley.

Q. That is a matter of difference in expert opinion, is it not, as to what is the proper treatment of the sewage of the Passaic Valley?

A. That is my opinion. I do not know that I can speak for other people on the subject.

Q. You know that there are other engineers of some standing who have recommended this other plan, do you not?

A. Yes, sir.

Q. Do you know who they are, any of them?

A. Some of them are more eminent than I.

Q. That is a difference of opinion, is it not? Expert opinion?

A. Surely.

Q. Is there any way, in your opinion, of treating the sewage of the City of Newark so that the effluent will be fit to discharge into Newark Bay, which will be more economical for that city than the proposed plan of the Passaic Valley Sewerage Commissioners, so far as purification is concerned?

A. I do not know that there is any method which will be more economical, but I believe there is which would be as economical and more efficient.

Q. What would that be?

A. The purification of the City of Newark by independent plants, not necessarily all concentrated at one point, but so located that they might receive the sewage as fresh as possible and oxidize it to the point where it would not make so great a reduction in the oxygen in the waters of Newark Bay.

Q. I am speaking now of the effluent that would be fit to
2761 discharge into Newark Bay. Do you think there are plants for doing that more economically, that are feasible, do you, than the proposed plan of the Passaic Valley Sewerage Commissioners; that is what we are attempting to compare these other plans with?

A. It appears to me that I answered that question in my previous answer. That there are probably no plans which are more economical than for Newark to join in the trunk sewer, but there are plans which are probably as economical and more efficient, so far as the character of the effluent is concerned, for the City of Newark.

Q. And where do you locate the sectional disposal plants?

A. I have not attempted to do so.

Q. You do not know whether as a matter of fact there is any suitable locality?

A. Oh, yes.

Q. Where is there a suitable locality in the City of Newark for any such plant?

A. I think there are suitable localities between Newark and Newark Bay, all along the line of Newark. I recall vast stretches of tidal meadows which in my opinion might be utilized for such purposes, without detriment to the surrounding localities.

Q. Well, you saw vast stretches; what do you mean by that. What do you intend by "vast" in connection with that territory; how many miles?

O. Several square miles in area.

Q. You call that a vast territory?

A. Considered in relation to sewage disposal sites for the city, yes.

Q. And how many sections, in your opinion, will such a plant or plants serve beyond what is to be served by the proposed disposal plant located on those very meadows?

A. I have not made any detailed study. I simply outline the subject, which is I believe worth detailed study, and which is I believe practicable.

Q. Don't you know that it would require the reconstruction of the whole local system of the City of Newark to adopt any such plan as you have suggested?

A. No, sir.

2762 Q. You do not know anything as to the local sewage in Newark, do you?

A. I am not extensively informed as to the local sewage, but speaking generally in most cities of that size it is not difficult to intercept large portions of the city and lead them to various sites where purification may be utilized.

At 1 P. M. adjourned for noon recess until 2 P. M.

CORPORATION COUNSEL'S OFFICE,
NEW YORK CITY, July 1, 1912—2 o'clock p. m.

JOHN W. ALVORD, a witness called on behalf of Complainants, recalled for further examination, testified as follows:

Cross-examination by Mr. Riker (resumed):

Q. Mr. Alvord, do you know the proportion of the capacity in the proposed sewer that is allotted to Newark?

A. I have seen the percentages.

Q. Do you remember it to be 46 per cent., about?

A. It seems to me that was about it.

Q. Is that the ultimate capacity—I mean by that is that the capacity throughout the whole estimated life of the sewer, as you remember it?

A. I do not recall that.

Q. You do not know whether there is any change from the allotment as of the time of the beginning of operation and the year 1940?

A. No, sir.

Q. Would a percentage of 46 from the nearest territory to the disposal works have any effect on your estimate of the average age of the sewage to be disposed of at that point?

A. Not greatly. Sewage age is not altogether a matter of hours. It is a matter of its septic condition when it arrives at the plant. Its age, therefore, is only very roughly measured by hours.

2763 Q. The age of a part, or a considerable part of the sewage, in your opinion, has no important effect on the probable character of the sewage?

A. It is only a general way of stating its septic condition at the outlet.

Q. Have you not rather been considering the septic condition at the disposal works, as determined by the age of the sewage?

A. Yes, sir; in order to give a rough idea of the thing I have assumed for the moment that generally the septic condition would correspond with the age of the oldest sewage, or nearly that.

Q. Have you any other basis upon which to determine in any way the probable septic condition of the sewage when delivered at the proposed disposal plant of the Passaic Valley Commissioners except the age?

A. None that I could cite with more definiteness.

Q. And I think you gave an estimate in view of the probable age of the Newark sewage at the disposal plant?

A. Yes, sir.

Q. What was that?

A. If I recall rightly, I think from 4 to 7 hours.

Q. And you think the fact that 46 per cent. of the sewage is not older than 7 hours would have no effect on the septic condition of the whole discharge at the disposal plant?

A. Not a material one.

Q. Does the City of London purify its sewage?

A. Yes, sir.

Q. Do you know where the disposal plants are located?

A. One is located at Crow's Nest and — on the Barking.

Q. What is the age of the sewage when discharged at the first of the plants named by you?

A. I would not be able to state definitely.

Q. Cannot you state approximately?

A. The sewage is conveyed to the outlet by an intercepting sewer of a good many miles in length. There is a northern outfall sewer and a southern outfall sewer. I should think from my best recollection certainly over 25 to 30 miles in length.

Q. Well, then, sewage discharged at those disposal plants, in your opinion is it as old as the age of the proposed discharge of
2764 the disposal plant at the Passaic Valley Sewer?

A. I should think it might be, yes, sir.

Q. Might be older might it not?

A. Might be older, yes, sir.

Q. Do you know as to the quality of it with reference to concentration, as to whether it is as concentrated as that which is likely to be discharged from the Passaic Valley?

A. More concentrated than that which would be received from the Passaic Valley, in my opinion.

Q. Where is the effluent discharged?

A. The effluent is discharged into the Thames River.

Q. How far from its mouth?

A. I could not say. The Thames, at a point vanishes into an estuary, and I would not say without looking the matter up.

Q. Do you know how many inhabitants the City of London has?

A. Well, something exceeding five millions.

Q. Considerably?
A. Yes, sir. I do not carry the figures in my mind.
Q. What is the character of that effluent?
A. Very poor, in my opinion, when I saw it.
Q. What is the treatment given to the sewage?
A. Chemical precipitation.
Q. Anything else?
A. Nothing else I am aware of, unless it has very recently been introduced.
Q. The age of the sewage does not prevent its treatment does it, at the London disposal plants?
A. No, it does not prevent its treatment. You can attempt to treat sewage of almost any age, but you may not succeed in purifying it.
Q. Speaking generally, is the treatment given to the London sewage of a higher order of efficiency, in your opinion, than that which is described in the specific means that are included in the stipulation, Complainants' Exhibit No. 135?
A. It is not so good as is stipulated for here.
Q. I am speaking now of the appliances and means specifically described in the stipulation; you have that in mind, have you?
A. Yes, sir.
2765 Q. The London treatment is not as good as that treatment?
A. I was referring to the stipulation—if you were referring to the specific appliances——
Q. That is what I asked.
A. I do not know as I could give an opinion on that, because it has been a great many years since I have seen that effluent. My visits to those works were made as early as 1888, and without some careful examination of the analytical data I would not like to venture an opinion. My impression at that time was that the effluent was very foul and contained suspended matters, visible color, odors.
Q. Do you know anything about the sewage of the City of Berlin?
A. Yes, sir.
Q. How is that treated?
A. That is purified on an extensive sandy plain both to the north and to the south of the city. I visited that plant also in 1888.
Q. How far is the nearest one of the Berlin disposal plants to the city?
A. I am unable to say definitely now, but I took a train, a somewhat slow train, and proceeded probably thirty or forty minutes before I arrived at the station from which I walked over to the southerly purification fields.
Q. In your opinion what is the age of the sewage when delivered at that purification plant?
A. Well, it is fairly old sewage.
Q. As old as that likely to be delivered at the disposal plant of the Passaic Valley Sewerage Commissioners?
A. Yes, sir; I should judge it was.
Q. Where is the effluent from that discharge?

A. The effluent from that is discharged into various small streams, drains, which lead ultimately into the Spree, I think it is, the river.

Q. How do the means for purification in that disposal works which you visited compare with those specifically described in the stipulation, Complainants' Exhibit No. 135?

A. The effluent there is in my opinion considerably better than would be produced by the means proposed in the stipulation.

2766 Q. Well, there is no practical difficulty, then, in producing an effluent from sewage as old as that which you estimate to be likely to be the age of the Passaic Valley sewage at the disposal works?

A. There is no practical difficulty in Berlin, but there would be a very great difficulty in Newark Bay.

Q. In producing the same effluent?

A. Yes, sir.

Q. Why?

A. Because Berlin is naturally provided with an extensive sandy plain, which, by means of irrigation is quite effectual in producing a fairly good effluent at somewhat large expense. I believe the area upon which such effluent is produced exceeds the area of the City of Berlin itself. No such natural conditions exist in Newark Bay, to my knowledge, that could be utilized in such manner.

Q. Do such natural conditions as you have described in Berlin exist about London, that you know of?

A. Not that I know of.

Q. You have spoken of the natural course of the sewage from the Passaic Valley. What is that natural course?

A. The natural course is into the Passaic River and into Newark Bay, and from Newark Bay partly through the Arthur Kill and partly through the Kill van Kull, and in the one case to the Lower Bay and in the other case to the lower part of the Upper Bay.

Q. Above or below Robbins Reef Light, so far as the part which goes into the Upper Bay is concerned?

A. Below.

Q. How much?

A. About a mile, I should judge.

Q. Now, what is the natural course of sewage, if you can define it. Is there any such thing?

A. The natural course of sewage is through the drainage area in which it is created and through the outlet waters thereof.

Q. Is it not a fact that every sewer that is constructed is an unnatural course for the sewage to take?

A. No, it generally is along the natural lines, seldom otherwise.

2767 Q. And discharging sewage at a lower point than it would reach by nature; every sewer that is built does or does not that discharge the sewage which it does discharge at a point lower down the drainage area than it otherwise would reach?

A. I do not understand that question. If by lower you mean lower down in the valley, I should say hardly, and if by lower you mean at a lower elevation, I should also say hardly.

Q. You have in mind exceptions where the sewage is pumped I suppose?

A. The exceptions where sewage is pumped do not always mean that it was discharged lower in the valley.

Q. Are you familiar with the Bronx Valley Sewer?

A. Not particularly, except as I have read about it in the various reports connected with this case.

Q. A large part of your testimony in this case is based on reports that you have read, is it not?

A. No, sir. I would not say a large part, but a considerable part. We obtain our knowledge naturally from the written word as well as from direct observation.

Q. Have you read enough about the Bronx Valley Sewer to be able to say whether or not that is a natural or unnatural course for the sewage of that valley?

A. I think I have.

Q. Is it or is it not?

A. If I understand the Bronx Valley Sewer, it follows down the natural drainage a certain distance, and toward this lower end is diverted out of the natural valley in which it is created, and diverted by means of a tunnel into the Hudson River at a point higher up than it could possibly reach by natural drainage.

Q. Then, that is an unnatural course for the sewage of the Bronx Valley?

A. In part it is.

Q. Is it not an unnatural course for the greater part of the sewage of the Bronx Valley?

A. Speaking of the greater part, referring to the quantity of sewage, it is.

Q. And for the greater part of the distance is it not an unnatural course for the sewage?

A. For the greater part of the distance I should think it was not. It is a natural course through most of the distance, and through the lower portion an unnatural one.

2768 Q. At what point in the natural line of the water courses with reference to their final discharge into the ocean do you limit the natural course of sewage?

A. I think strictly speaking the natural course of the sewage would follow the natural course of the water courses.

Q. And would you say that a discharge of the sewage of the Passaic Valley into Newark Bay was following the natural course for sewage in the Passaic Valley?

A. Yes, sir.

Q. Would the discharge into the Kill van Kull be following the natural course?

A. It would be following the natural course of a part.

Q. Do you know what percentage?

A. I think it is about 80 per cent., if I remember rightly, passes through the Kill van Kull.

Q. Would 84 per cent. refresh your memory as to just what the estimate was?

A. Possibly you are right.

Q. Then as to 84 per cent. it would be a natural course?

A. Yes.

Q. And the discharge at Robbins Reef, would that be natural for 84 per cent.

A. No, sir, because it would be somewhat higher at the bay than it would naturally discharge from the influence of the tide.

Q. Discharging at a depth of 40 feet below the surface you think that would be a natural course for the sewage?

A. No, sir.

Q. If it is discharged further down the bay, below Robbins Reef, would you then say that was the natural course for the sewage in Newark Bay?

A. Yes.

Q. And from the Passaic Valley?

A. Yes, sir.

Q. So it is only a matter of the position of the outlet which induces you to say that it is not a natural course of the sewage of the Passaic Valley to at least an extent of 84 per cent?

A. It is only the position of the outlet that induces me to state that.

Q. In its location in the bay of New York?

A. Its location in the bay of New York is not its location that it would naturally take.

Q. And the location in the bay of New York would be, however, the natural course of the sewage at least to the extent of 84
2769 per cent., from the Passaic Valley, would it not?

A. Yes, sir.

Q. You have described the effect of the discharge of the Passaic Valley Sewer in the waters of New York Bay. I think in that connection you used the expression "raw sewage" did you not?

A. I do not recall what you are now referring to.

Q. In describing the effluent upon the surface of the water from the proposed discharge of the Passaic Valley Sewer, you described it as being "raw sewage."

A. I was not aware that I used that term.

Q. Just where is the proposed outlet located with reference to the territory of the State of New Jersey?

A. My understanding is that it is within the State of New Jersey, but in the immediate proximity of the boundary line of the State of New York.

Q. Immediate proximity—do you know how far that is?

A. No, I do not, very closely. My impression is that between a half and a quarter of a mile would perhaps cover it.

Q. You have spoken of the harbor waters of the City of New York. Do you refer to the part within the territory of the State of New Jersey as part of the harbor waters of the City of New York?

A. Yes, sir; I refer to the harbor waters of New York as being distinctively those in which the major portion of the waters of the harbor are in the State of New York, recognizing the fact that the lesser portion is within the State of New Jersey.

Q. You have testified that the waters of the Bay of New York are approaching a dangerous point of pollution, have you not?

A. Yes, sir.

Q. And that danger is occasioned by what discharge of sewage?

A. Largely by the discharge of sewage from the Borough of Manhattan and Brooklyn, and to some extent from the shores of New Jersey. I have some evidence that some of that pollution, a considerable portion of it, is also from New Jersey.

Q. What percentage of pollution is attributable to the State of New Jersey, in your opinion?

A. Very much the smaller portion. I do not like to go
2770 into exact figures without some care.

Q. You have estimated the probable population of the Metropolitan Sewerage District in 1918, do you remember doing so?

A. Yes, sir.

Q. Do you remember what that was?

A. About 7,600,000 people.

Q. And how much of that population do you estimate to be likely to be New York State population?

A. Why perhaps five-sixths, or thereabouts.

Q. Have you proposed in your own mind, then, any plan of purifying the sewage from the communities within the State of New York?

A. To some extent, yes, sir.

Q. You have gone into it for the benefit of the Passaic Valley in a broad way?

A. Yes, sir.

Q. Have you gone into it for the State of New York in a broad way?

A. To some extent, yes.

Q. Are you contemplating, as proposed, the establishment of these local purifying plants to treat the fresh sewage of the Borough of Manhattan, for instance?

A. I believe that it will be inevitable that the City of New York will have to in the future take steps to largely purify its sewage.

Q. Those steps will be in your opinion the establishment of local purifying plants for treating the fresh sewage?

A. Very largely.

Q. Where will they be located in the Borough of Manhattan?

A. My idea is that the sewage of the Borough of Manhattan, being the most costly part of the district to provide for, purification should be allowed to use as far as possible the waters surrounding for that purpose, with local retention of solids as far as possible and practicable. That in order that the Borough of Manhattan might utilize those waters, the sewage from other portions of the district, such as the Borough of Brooklyn and the Borough of Richmond and the Borough of the Bronx, which can more readily provide for purification, should establish at various points local plants, intercepting sewers, pumping stations, by means of which the impurities shall be kept from the waters of New York Harbor.

Q. And purely on the basis of financial considerations, these other communities, they include the shores of New Jersey?

2771 A. Where it is possible at least cost, yes.

Q. On the basis of financial considerations, then, you suggest that these other communities located on the ripa of New York Bay should be put to the expense of purifying their sewage in order that the Borough of Manhattan, and part of the Borough of Brooklyn, certainly the Borough of Manhattan might have the ability and leave to discharge directly into the waters of the bay; would that be your proposition?

A. That would be in brief my position, because, as I look upon it, the problem is one and is indivisable in its ultimate economic aspects. The harbor of New York is common to the municipalities of the State of New Jersey and the municipalities of the State of New York they enjoy in common its advantages. They should in common plan along the most economic lines for its ultimate preservation and a united endeavor would accomplish such purpose.

Q. And it is your opinion that the municipalities and communities of the State of New Jersey should subject themselves to largely increased expense in the disposal of their sewage in order that the Borough of Manhattan and some other parts of the State of New York should have the opportunity of discharged crude sewage into the waters of the bay?

A. Not greater than the Borough of Manhattan. I simply speak of the Borough of Manhattan as facing a much greater cost for any practical purification of its sewage than will any of the surrounding communities. It should do, however, in my opinion, all that is proper and economically possible to eliminate the solids from its sewage before it is emptied into the waters of the bay, and, in my opinion, speaking in a general way, this will be about as costly for the Borough of Manhattan as more complete purification will be for the surrounding boroughs and the State of New Jersey.

Q. Then in your consideration of this subject you do not take into consideration the separate sovereignties of the states of New York and New Jersey?

A. I do not look at it from a local or sectional standpoint. To my mind it is one problem of sanitation which concerns all the surrounding communities of this district under consideration, and, as such problem, I think it should be treated on broad gen-

2772 eral advantageous lines which should not, in my opinion, tax any one portion of the communities at any excessive rate over any other portion.

Q. That is a long answer. I think I will ask the question again. You do not take into consideration the soverign territorial jurisdiction of the states of New York and New Jersey?

A. Not so far as relates to the ultimate solution of the problem.

Q. And you do not recognize the soverign rights of either of those states in any particular portion of the sewage disposal capacity of the waters of the bay?

A. Yes, I recognize the right in both these soverign states to obtain a joint participation in the waters of the bay, but I recogn-

that both must use such right with due regard to the right of each other.

Q. And do you in that take into consideration anything beyond the creation of a nuisance in the waters of the bay by either of the states?

A. I do not understand the import of that question.

Q. You have testified that in your judgment the discharge of the sewage from the Passaic Valley Sewer will create a nuisance in the waters of New York Bay, have you not?

A. Yes, sir.

Q. Does the discharge, as you have observed it, from the sewers of the greater city of New York create a nuisance in the waters of the bay?

A. Yes, sir, I believe that is true, and I am certainly of the opinion that the City of New York should proceed to abate that nuisance as rapidly and as quickly as a consistent careful study of that problem will allow.

Q. What is the City of New York doing, so far as you know, to abate the nuisance?

A. It has been attentively studying the problem of the pollution of the harbor waters since the year 1906, if I am not misinformed.

Q. What has it done besides studying them looking toward the purification of the sewage discharge?

A. It has proceeded, through its Metropolitan Commission, against the Bronx Sewer, if I am not mistaken. It has created circulation in the waters of the Wallabout Bay and Gowanus Canal in an attempt to ameliorate conditions in that part of
2773 the harbor, and it has built certain works in connection with Newtown Creek, if I am not wrongly advised, in an attempt to ameliorate conditions there, and it has formulated and is formulating general plans for the district plants which have been suggested.

Q. And in the specific things that it has done, which you have named, the improvement in the Gowanus Canal, for instance, the purpose is the alleviating of the conditions immediately surrounding the water in question, on the shores, is not that it?

A. It is fair to say that is true.

Q. And it has transferred the nuisance out into the waters of the bay?

A. Well, to a large extent, although that is not wholly so.

Q. And in Newtown Creek has that same thing been accomplished?

A. To some degree.

Q. Even in the Bronx Sewer Project, the result of that will be, when it is put into operation, will be the discharge into the waters of the Hudson of the sewage which otherwise would not reach the waters of the Hudson River.

A. That is true.

Q. And on the opposite shore of the Hudson at that point is the State of New Jersey?

A. Yes, sir. These matters necessarily have to move slowly. The

subject of purification, and especially as relating to harbor waters, is a complex one. It is now being attentively studied. Its solution is not simple but complex, and it is natural that time is consumed in arriving at a definite program which can be safely followed.

Q. Well, there are recognized methods of purification which are adopted generally by large cities not located on tidal waters?

A. Yes, sir.

Q. Are there any recognized purification methods that are adopted by cities located on tidal waters that you know of?

A. Yes, sir.

Q. Where?

A. The City of Baltimore, for instance, is establishing a large purification plant which is going to cost many millions of dollars, in order to entirely divert the sewage from its harbor.

2774 Q. Is that a land-locked harbor?

A. Yes sir.

Q. Is it of the same character, except in respect to sea water—I mean by that salt water—as the Bay of New York?

A. Well, I should not call it entirely of the same character. It is more in the nature of an estuary than a harbor like New York, through which opposite tidal movements occur.

Q. What other city on tidal waters do you know of that is purifying its sewage?

A. If I am not mistaken the City of Hamburg has made extensive plans for the purification of its sewage. Melbourne, Australia, provided quite a number of years ago for purification of its sewage.

Q. What system is in use in Hamburg?

A. I am not informed as to the plans. I do not understand the plans are carried out as yet, but they are merely proposed.

Q. Do you know whether, as a matter of fact, there is anything in the way of purification applied to the sewage of the City of Hamburg?

A. I do not think there is.

Q. Do you know anything about the system at Melbourne?

A. Very little. It was reported on some 20 or 25 years ago, and careful studies were made of the tidal flows. It is a land-locked harbor, somewhat similar to that of New York except that the tidal currents do not come through it in opposite directions, and the sewage, as I recall, is collected by intercepting sewers and pumped a considerable distance from the city and purified. I do not now recall the means of purification.

Q. Is there any body of fresh water comparable with the waters of the Hudson River discharging into Melbourne Harbor?

A. Not such a large and important river by any means. There is a small river.

Q. Does the discharge of this water of the Hudson River, in your opinion, have any value in the sewage disposal problem of the Bay of New York?

A. Some value, not as much as it might have were it not already polluted by the sewage of the communities to the north of New York City on both sides of the river.

2775 Q. In what state?

A. Well, largely in the State of New York.

Q. Any from the State of New Jersey?

A. Not that I recall.

Q. Do you know, Mr. Alvord, who prepared the specifications for the plant as described in the stipulation between the United States and the State of New Jersey, Complainants' Exhibit No. 135?

A. No sir.

Q. Don't you know it was Colonel Black?

A. No sir, I did not.

Q. It is your opinion, is it not, that the effluent from the works as described in this stipulation will not be of a character to produce the results stipulated for in the agreement itself as to the effect of the effluent?

A. It is my opinion that the character of the effluent stipulated for will not be produced by the works stipulated for.

Q. Now, will you point out in the stipulation where the effluent is described as a specific thing?

A. It is not directly described as a specific thing.

Q. It is only described in its effects upon the waters of the Bay of New York, is it not?

A. Very true.

Q. Now, I ask you whether it is your opinion that the effluent from the works as described in the stipulation will or will not produce the results which are stipulated for in this agreement?

A. My opinion is that the waters coming from a plant such as is described in this stipulation will not produce the results upon the waters of the Harbor of New York as stipulated.

Q. Do you think that there will be an absence in New York Bay of visible suspended particles coming from the Passaic Valley sewage, if that sewage is discharged from the works as described specifically in the stipulation?

A. I think there will not be an absence if such effluent comes from works as specifically described.

Q. In what way will suspended particles be visible in the waters of New York Bay, in your opinion?

A. By a visual examination.

Q. When you say examination, just what do you intend by that?

A. I mean an observation.

2776 Q. From what point?

A. From the decks of boats.

Q. And will it in your opinion produce a sewage field about the outlet?

A. It will.

Q. And will it produce sleek fields, in your opinion?

A. Yes, sir.

Q. About the outlet?

A. Yes, sir.

Q. That is the effluent from the works as described in the stipulation will produce at the outlet point sewage fields and sleek fields, in your opinion?

A. Yes, sir.

Q. Will it produce deposits in New York Bay of solid matter?

A. Yes, sir.

Q. And will it produce odors due to the putrefaction of organic matters in New York Bay, in your opinion?

A. Yes, sir, at times.

Q. And it will produce grease and color of course, if there are sewage fields and sleek fields?

A. Yes, sir, at times it will be more noticeable than others.

Q. And will it produce injury to the jublic health in your opinion?

A. That I am unable to say.

Q. And will it produce a public or private nuisance in New York Bay?

A. I think in connection with the other pollution in New York Bay it will produce a public and private nuisance.

Q. But, taking them separately, do you think it would produce a public or a private nuisance in New York Bay?

A. If there were no other pollution in New York Harbor I might have some doubts about it.

Q. How would it cause reduction in the dissolved oxygen contents of the waters of New York Bay to such an extent as to interfere with major fish life?

A. I am unable to say, as I do not know, nor do I think it is generally known, as to what reduction of oxygen materially interferes with major fish life, especially over long periods of time.

Q. Now, Mr. Alvord, is or is it not possible to add other processes and other means and appliances to those specified in the stipulation which will produce an effluent of a character to produce the results stipulated for in this agreement?

2777 A. Yes; theoretically, I believe it is.

Q. Practically, is it not?

A. Practically I think it could be done at such an enormous expense in connection with the works described, that other more economical methods would be far preferable and more efficient as well.

Q. Are you contemplating from these other agencies which you have in mind an effluent of as high a character as that described in this stipulation?

A. Yes, sir, in many respects. The processes which I had in mind are all provided with a stage in which the oxidation of the impurities in solution will be accomplished.

Q. You do not think the effluent which is stipulated for in this agreement requires a similar process in order to produce it?

A. In some respects, yes, and in other respects, no. As to its color, odor, suspended matters, it will require other processes to eliminate these, and as to the dissolved oxygen requirement in the stipulation it might not require other processes.

Q. Well, now, if you remove from the effluent the suspended particles that they are not visible, and if you remove such agencies for producing odors, and if you remove the grease and color, in your

opinion will that effluent be so reduced in organic matter as to be likely to reduce the dissolved oxygen in the waters of the bay?

A. In my opinion it would still reduce the dissolved oxygen in the waters of the bay, even if all those other things were removed.

Q. If you remove all those other things you have removed a very large part of the organic matter?

A. Yes sir, and it is true that the reduction of the dissolved oxygen in the waters of the bay would not be so great as it will be with all those matters left in the effluent.

Q. In your opinion is the effluent as described practically the same as filtered water?

A. No, sir.

Q. If other experts have testified that that was the character of the effluent described, you do not agree with them.

A. Not entirely. It depends very largely on what is meant
2778 by filtered water. I take it by that term, filtered water, you mean water which is potable as well as clear and free from suspended matter and color, and using that definition the effluent would not be filtered water in the sense that it would still contain dissolved impurities, pathogenic bacteria, which might be inimical to health. In respect to color, suspended matter, and the other stipulations, they provide what is closely analogous to the filtered water so far as they go, but in one of the stipulations, as I recall it, it says there is to be only a practical absence of certain substances which would not make it comparable with filtered water, using the definition which I have used.

Q. You were present when an expert on the stand here testified that in his opinion it was equivalent to filtered water, were you not?

A. I do not recall hearing that remark.

Q. Have you not heard any expert speak of it as equivalent to filtered water while you have been here?

A. No, sir.

Q. Is filtered water, in your understanding of the term, equivalent to potable water?

A. As used by sanitary experts, we generally regard it as such unless qualified. There may be filtered water, of course, which is not portable. That is because the filteration is not adequate, but generally speaking we call filtered water water which is presumably passed through a filtering operation which renders it potable.

Q. You think the scientific definition of it, then, is practically synonomous with potable water, do you?

A. As commonly used.

Q. I am asking you for the scientific use?

A. I think there is no scientific use of it other than the one in current use among sanitarians.

Q. Did not you say on your direct examination that in your opinion this effluent as described in the stipulation was of a character that was impracticable by reason of its cost to the communities, but it would be unobjectionable if discharged into the waters of New York Bay?

A. No, sir.

2779 Q. Is it not your opinion that that would be the fact?

A. I said that I thought the stipulation, owing to the fact that it calls for an almost perfect effluent except as to various impurities capable of absorbing some dissolved oxygen, makes the stipulation, in my opinion, impracticable.

Q. Is it not a fact that it is an almost perfect effluent as described?

A. In some respects, yes, and in other respects, no.

Q. Well, now, in what respects no?

A. It is not perfect as to the impurities in solution, which will reduce the dissolved oxygen in the waters of the harbor.

Q. To what extent will it reduce the dissolved oxygen in the waters of the Upper Bay, taken as a whole?

A. I am unable to say with precision.

Q. One per cent?

A. I am unable to say with precision.

Q. Would you say it would exceed one per cent?

A. I would not venture on any figures indicating a precise opinion. I would say, however, that bearing all the surrounding circumstances in mind, considering the amounts of pollution already existing in the harbor, and the sludge beds upon the bottom of the harbor, and that the emptying of this quantity of sewage, amounting as it will in 1940 to over 1100 acre feet of sewage per day, it would in my opinion, so reduce the dissolved oxygen of the harbor that large fields of water now on the verge of being insufficiently filled with oxygen would be reduced below permissible and preventable limits, and that nuisances already existing would thereby be increased, while other nuisances not now existing would be created.

Q. You will observe that you do not answer my question. My question is whether an effluent of the character described in New York Bay will reduce the dissolved oxygen in the waters of the bay on the average one per cent. in your opinion?

A. Well, I should not like to answer any such question put in any such form.

Q. Are you willing to say any more than any organic matter discharged in any way into the bay will result in a reduc-

2780 tion of the dissolved oxygen?

A. Yes.

Q. What else will you say?

A. I am willing to say the quantity of pollution emptied into the bay has a very material bearing on the amount of reduction, and that pile of pollution existing in the bay, taken in connection with the pollution emptied into the bay, will also have a very material effect on the reduction of the dissolved oxygen, but I am unable to compute from any data which we have the precise percentage which any given quantity of sewage similar to that stipulated will have upon the dissolved oxygen of the waters of the bay.

Q. You have ventured to give in your direct testimony some reasons for your belief that the discharge of the sewage into New

York Bay from the Passaic Valley Sewer will result in injurious effects, notwithstanding this stipulation, do you remember that?

A. No, sir.

Q. Do you remember giving a number of reasons why, after your study of the stipulation, you were of the opinion that the discharge of sewage from this sewer would result injuriously to the waters of New York Bay?

A. Yes, sir.

Q. Now, what was the first of these reasons?

A. That the interests of the United States and the City of New York are not identical.

Q. Now, what has that got to do with the question whether the effluent stipulated for shall produce the results stipulated for or not?

A. It is the reasoning which I think you are alluding to, and they are the reasons which I gave as to why I thought the stipulation was impracticable, of enforcement.

Q. You mean by that, do you, that the United States will not see to the enforcement of this stipulation in the way in which it was prepared and signed?

A. I mean what I say. The interests of the United States and the City of New York are not identical.

Q. I ask you whether you mean by that the United States will not see to it that the stipulation is lived up to by the State of New Jersey?

2781 A. I have made no such inference in what I have said. I have simply said their interests were not identical. That, in my opinion, would render it difficult for the City of New York to obtain practical enforcement of these stipulations.

Q. You understand the City of New York is not a party to this litigation?

A. I beg pardon—whatever you mean—whatever is the proper term—the State of New York.

Q. That because of the fact that the United States is not identical with the State of New York, therefore the agreement will not be carried out, is that your process of reasoning??

A. I beg pardon. I said the interest of the United States and the State of New York.

Q. Very well, the interests of the State of New York and the United States are not identical, and therefore you conclude that the agreement, the stipulation, will not be performed by the State of New Jersey or enforced by the United States?

A. I conclude it will be difficult for the State of New York to obtain a practical enforcement of the stipulation, because of that fact.

Q. Yes, I understand that. What do you mean, that the stipulations will not be carried out in your opinion?

A. That is venturing on much more than I have said here and about which I prefer not to go on record. I said here that it would be difficult to obtain practical enforcement of those stipulations,

because the interests of the United States and the State of New York were not identical.

Q. Do you or do you not mean by that that if, in the opinion of the State of New York, the stipulations were not lived up to, it would be difficult for the State of New York to secure what it thought to be a practical enforcement of the stipulations?

A. Yes, sir.

Q. You do not mean to be understood as venturing the prophesy that the stipulation will not be carried out?

A. Not in this particular case. I am not alluding to that. I am alluding to the difficulty which the State of New York will
2782 find in obtaining through the United States Government the enforcement of these stipulations, by reason of the fact that the interests of the state and the United States are not identical.

Q. In that statement you are assuming, are you not, a condition where the stipulations are not being carried out?

A. I am assuming that questions may arise upon which the parties interested may differ.

Q. You are assuming that a condition will arise in which the stipulations are not being lived up to, are you not?

A. Well, I am willing to say that, yes. I am assuming that a condition will arise where the stipulation will not be lived up to. In fact I believe the stipulations cannot be lived up to.

Q. Will you tell us why they cannot be lived up to?

A. Because I think it is a practical impossibility to enforce them as described.

Q. And in your opinion unless they are enforced they will not be performed?

A. Yes, sir.

Q. And in your opinion the State of New Jersey and the Passaic Valley Sewerage Commissioners will not in fact perform the stipulation?

A. Not will not, cannot.

Q. Tell us why they cannot?

A. Because they have undertaken to do something here which, so far as described in the stipulation, is practically impossible.

Q. You mean that an effluent cannot be produced which will be of the character described?

A. Cannot be produced by the means described.

Q. But, Mr. Alvord, you seem to forget that it is provided in this agreement that if the means described are not sufficient there shall be others used, are you bearing that in mind?

A. Other lawful means may be used.

Q. You would not expect that the State of New Jersey or the Passaic Valley Sewerage Commissioners would use unlawful means?

A. I should hope not.

2783 Q. Leaving that out of consideration, and directing your attention to lawful additional arrangements, have you any question that those are practicable?

A. I have a very great question as to what the word lawful means.

Q. I am leaving that out for the present.

A. I do not see how that can be left out.

Q. Do leave it out of consideration here, you let me ask you, leaving that out of the consideration, is there any doubt that this effluent can be produced, either by the means specially described, or by requisite additional arrangements?

A. I think theoretically, at a very large cost, much larger than would be necessary with other arrangements, other additions might be provided for which would at least at times produce such an effluent as stipulated.

Q. You would have been disposed, if you had been consulted by the Passaic Valley Sewerage Commissioners, or these municipalities, to have recommended something like the Imhoff Tank, is that what you mean?

A. No, I hardly know what would be requisite. I think it would be a matter of very considerable study, because the stipulations are so peculiar, because they require some things very explicitly and leave out other things which in many plants are not allowed.

Q. Do you know under whose supervision the stipulations were drawn up, as far as the United States is concerned?

A. No, sir, only as you have informed me.

Q. Did you not know that Colonel Black had something to do with them?

A. I did not prior to your informing me of it.

Q. I show you the exhibit, and you will observe that they are signed on behalf of the United States by the Attorney General, George W. Wickersham?

A. Yes.

Q. You do not raise a question as to the legal features of the agreement, do you?

A. I do not raise any question as to the power of the United States to carry out its part of the contract. I do question very seriously the ability of the State of New Jersey to carry out its part of
2784 the contract in any reasonable way, at any reasonable cost.

Q. And your conclusion is, is it not, that finding the expense greater than they anticipated, the State of New Jersey and the Passaic Valley Sewerage Commissioners will proceed to violate the stipulation?

A. Not intentially, but I think that will be the result, unintentionally.

Q. So that it is not in your judgment a question as to the efficiency of the stipulation as to results in the effluent which is in question so much as either the intention or the ability of the other two parties than the United States to carry it into effect?

Mr. O'Sullivan: I object to that question on the ground that it calls for a judicial function on the part of this witness which he has not been qualified to perform. I also object on the ground that it calls for an extremely intuitive knowledge of psychic conditions to attribute any intention or other impulse to a state.

The Commissioner: Note the objection of counsel for complainants.

A. Yes, it is a question as to whether the stipulation, as well as the practical effluent, and as well as the ability of the State of New Jersey to carry it out, the question of the stipulation as being a practical one and the question of the possibility of producing such an effluent with the means described.

Q. Or any means?

A. Or any practicable means at reasonable cost.

Q. You recognize there a possibility of difference of opinion of experts on that subject?

A. Yes, sir.

Redirect examination by Mr. O'Sullivan:

Q. Mr. Alvord, directing your attention to Complainants' Exhibit No. 135, I ask you in looking at that stipulation if you consider that the plant described in it will yield the results stipulated for?

A. I do not.

Q. Mr. Riker asked you some questions relative to the discharge at Robbins Reef and the present method of the sewage disposal in the Passaic Valley region. What do you regard as the difference between what you have already described as an unnatural outlet and the present mode of disposal of the sewage of that valley?

A. The difference in my opinion is that the natural outlet
2785 of the sewage, proceeding as it does through the Passaic River in which it is largely septicized, and later on diluted with the waters of Newark Bay, arrives at its natural outlet in such a condition as to not so seriously affect the waters of New York Bay as it would if, in its crude state, it were conducted to this plant described, and thence conducted through a tunnel to Robbins Reef and discharged there.

Q. Is the present mode an ideal or other mode of sewage disposal?

A. The present natural mode is obnoxious, of course, to the communities in which it is taking place, but it is a natural method of sewage disposal.

Q. Treating the Passaic River and Newark Bay as part of a sewage disposal system by natural means, how would you describe it?

A. As a natural sewage purification plant.

Q. And what would come through the Kill van Kull as a result of this natural scavenging agency?

A. An effluent very largely purified.

Q. What you would expect, do you find it so?

A. Yes.

Q. And does it exist, as far as you know?

A. Yes, sir.

Q. Mr. Riker made some inquiries relative to the Manchester disposal works. Did you go there alone?

A. No, sir, I visited the plant in company with the Board.

Q. What Board?

A. The Conservancy Board I think it was called, and there was so much discussion on the way that I did not get an apportunity to see the direction or distance to which we were proceeding.

Q. And I think you estimated the time consumed in the public conveyance in going from the City of Manchester to the outfall?

A. About an hour, as near as I can remember.

Q. And at the rate you were going about what distance do you estimate that?

A. Perhaps six miles.

Q. Mr. Riker asked you relative to the investigations of the Metropolitan Sewerage Commission. Have they reached a stage to your knowledge where they have proposed remedies for the present polluted condition of the harbor waters?

2786 Mr. Riker: The question is objected to. There was no such inquiry as to what the City of New York was doing.

The Commissioner: Note the objection of counsel for defendants.

A. It seems to me they are now approaching that stage where they can begin to discuss in somewhat greater detail the methods which should be adopted.

Q. Mr. Riker asked you some questions relative to the Bronx Valley Trunk Sewer. Are you aware whether or not a $500,000 purification plant has been provided in connection with that trunk sewer?

A. I have been so informed. I was not fully aware that it had been appropriated for and was to be built.

Q. Were you aware that that was due largely to the agitation and information conveyed through the Metropolitan Sewerage Commission?

A. I am aware that the Metropolitan Sewerage Commission has taken an adverse stand against the emptying of unpurified sewage through the Bronx Valley Sewer.

Q. Mr. Riker asked you some questions about filtered water. Assuming that all grease, color, odor, suspended matter in solution, visible particles, turbidity and colloids be eliminated, would the effluent then resemble a filtered water?

A. It might resemble it, but it might still, if I understand your question, have pathogenic germs in it which would render it unfit for potable purposes.

Q. Mr. Riker asked you some questions relative to sovereign rights. How do you regard this problem as to the area?

A. I feel that this problem is inseparable and common as between the two sovereignties of New York and New Jersey. I do not see how it can be well solved without common cooperation between these two sovereignties. They are both equally interested in the preservation of the purity of the waters of this harbor. It is a common property in which they are both interested, and it appears to me that the logical and proper procedure for these two sovereign states to take on such a question is to agree upon some plan of just and equitable cooperation, which, if carried out carefully and conscientiously, will enable both of them to enjoy its advantages equally.

2787 Q. From your studies in this case have you information

as to whether or not the New York Bay Pollution Commission and the subsequent Metropolitan Sewerage Commission sought such co-operative efforts from the Passaic Valley Trunk Sewer Commission?

Mr. Riker: The question is objected to as immaterial and irrelevant.

The Commissioner: Note the objection of counsel for defendants.

A. I have been informed that such was the case.

Mr. Riker: I move to strike that out as hearsay on his own testimony.

The Commissioner: Note the motion of counsel for defendants.

Recross-examination by Mr. Riker:

Q. Is not all sewage treatment, even of the most primitive character artificial in a sense?

A. It is usually spoken of as artificial when it is accelerated and improved by the works of man, and it is usually spoken of as natural when it takes the course of Nature without aid from the works of man.

Q. Are not all sewers artificial devices?

A. Yes, sir.

Q. Is not the purpose of all such devices to take the organic refuse and discharge it at some point away from the point of production?

A. Such measures are not made primarily for sewage purification. They are made for sewage transportation.

Q. I am not saying anything about purification. I am talking about all sewage devices. Are not they all intended to remove the polluting matter from the point of production to some other point?

A. No, sir.

Q. Where is there a sewer which does not result in that?

A. A sewage purification plant does not have such a purpose. A sewer is a transportation factor. A sewage purification plant is not a transporting factor. It is an artificial aid to natural agen-

2788 cies.

Q. Was the sewage produced at the purification or somewhere else?

A. Brought there by the water character of the sewage.

Q. And the sewage problem is, in the first instance, to remove the polluting matter from the point of production to some other point of discharge, either at a purification plant or at a point of discharge into the water?

A. That is generally the case; not always.

Q. Is or is not the Passaic River an artificial sewage disposal device?

A. I think it is not. I think it is a natural disposal device.

Q. Do you mean by that anything more than that it is a convenient disposal point?

A. I mean by that that it receives naturally the polluted wastes of the communities of the valley, and through the processes of nature, as well as possible, proceeds to purify them.

Q. You say it receives it naturally. Are there no artificial sewers that are conducting the refuse into the Passaic River?

A. It would receive those wastes were there no sewers.

Q. It would?

A. Yes.

Q. In what way would it receive them, to what extent?

A. It would not receive them to such an extent as it receives them with sewers, but it would still receive the foul wastes of the various communities.

Q. How would it receive these foul wastes except those that originated on the banks?

A. It would receive them through necessary ditches and necessary gutters.

Q. Is not that an artificial means in just as true a sense as the sewers themselves?

A. That is an artificial method of transportation.

Q. That is all a sewer is, is it not?

A. That is all a sewer is.

Q. I am not speaking now of any artificial devices for transportation. Do you mean to say that the Passaic River would receive the sewage if there were no artificial method of transportation?

A. Yes, sir.

Q. How?

A. Through the natural channels.

Q. What ones?

A. Whatever existed in the way of artificial channels.

2789 Q. To what extent?

A. To a less extent than it gets there now, but to a considerable extent.

Q. Then is it not a fact that every sewerage system is an artificial device for the disposal of organic wastes?

A. No, sir.

Mr. Riker: That is all.

Mr. O'Sullivan: If sewage were thrown, as it was a century ago on the land in front of the buildings where it originated, would the storm water create the gullies that you have just described and bring it down to its natural drainage area?

The Witness: Yes, sir.

Mr. Riker: What extent, what percentage?

The Witness: It will convey the sewage more during the time of floods than, as uniformly as now, through natural channels.

Mr. O'Sullivan: Are you through with this witness, Mr. Riker?

Mr. Riker: Yes, sir.

Adjourned to September 3, 1912, at 10.30 A. M.

2790 Supreme Court of the United States, October Term, 1910.

THE PEOPLE OF THE STATE OF NEW YORK, Complainants,
against
THE STATE OF NEW JERSEY and PASSAIC VALLEY SEWERAGE COMMISSIONERS, Defendants.

Before James D. Maher, Esq., Commissioner.

CORPORATION COUNSEL'S OFFICE,
September 3, 1912—10.30 o'clock a. m.

Appearances:

Dr. William J. O'Sullivan, Special Counsel for The People of the State of New York, Complainants.
Adrian Riker, Esq., of Counsel for Passaic Valley Sewerage Commissioners, Defendants.

Met pursuant to adjournment.

ROBERT SPURR WESTON, a witness called on behalf of complainants, being first duly sworn, testified as follows:

Direct examination by Mr. O'Sullivan:

Q. Where so you reside?
A. I reside in Brookline, Massachusetts.
Q. Where is your place of business?
A. Boston, Massachusetts.
Q. What is your profession?
A. I am a consulting sanitary engineer.
Q. Where were you educated Mr. Weston?
A. I graduated from Amherst College in 1891.
2791 Q. With what degree?
A. With the degree of Bachelor of Science, and I later got the degree of Master of Arts from the same college. Second semesters 1894 and 1895 and summer 1895 student, Massachusetts Institute of Technology; remainder of time, except summer of 1894 in laboratory of Massachusetts Experiment Station at Lawrence, in technical sugar laboratory and at Cinclare, Louisiana, Sugar Factory; May and June, 1895, assisted T. M. Drown in remodeling Asbury Park, New Jersey, deferrization plant; part of 1895 on field work for Massachusetts State Board of Health; September, 1895, to June, 1898, except September, 1896, to March, 1897, student, University of Berlin, with G. W. Fuller on Louisville water purification experiments; September, 1898, to February, 1899, conducted water purification experiments for the water company at West Superior, Wisconsin; 1899, designed and built filter for Henderson, North Carolina Water Company, also took part in tests and experiments at Louisville under George Fuller and at York Pennsylvania, and Homellsville, New York; July, 1899, to date in private practice as sanitary engineer, Boston, Massachusetts; 1899 to 1900 on

filtration experiments at Washington, D. C., under Lieutenant-Colonel A. M. Miller; 1900 to 1902 resident expert in charge of water purification experiments at city of New Orleans, under General Superintendent Sewerage and Water Board; 1902 and 1903 remodeled mechanical filter plants at Springfield and Jameco, Long Island, part of Brooklyn Water Works; 1903 to 1909 among other work on experiments and superintendence of filters, Knoxville Water Company, and conducted experiments on deferrization at Reading, Massachusetts, 1907 to 1909, and Rumford, Main, 1909, also less important experiments on water purification and sewage disposal; designed and constructed water filters for Exeter, New Hampshire, capacity 1,000,000 gallons, 1906, Fiskdale, Massachusetts, Stony Wold Sanatorium, New York, and so forth, sewage disposal plants for Stony Wold Sanatorium, State Hospital, Raybrook, New York, and so forth, and factory waste disposal plants for Draper Company, Hopedale,
2792 Hudson Worsted Company of Hudson, Massachusetts, and Illinois Leather Company, Lynn; designed water-works for Burrage, Massachusetts, and for several villages and estates.

Q. What other field of observations did you have?

A. I made two trips abroad to study sanitary questions, chiefly those connected with the purification of water and the disposal of sewage and the purification of streams.

I have reported on problems of water supply, water purification or sewage disposal; I have conducted tests at a number of cities and towns, also as consulting engineer have supervised construction of over $100,000 worth of structures for the Stony Wold Sanatorium in Adirondacks and 1902 to date have advised numerous users regarding quality of water for domestic, dietetic and industrial purposes, et cetera; at present I am engaged in constructing waste disposal for four plants for Hollingswirth & Vose Company; Wes Groton, including pumping plant, basins, and filter bed, and one-half mile of 10-foot sewer and settling tank for Nantucket, Massachusetts, water filters for Gorton-Pew Fisheries Company and Cunningham & Thompson, Gloucester; studying the Androscoggin River as to its character and the best method of improvement; preparing plans for plants for a bleachery, and for Holmes Manufacturing Company; also consulting engineer, Bureau of Water, Pittsburg, associated with G. A. Johnson in connection with studies for improvement of water filter operation and the overcoming of pollution of the Allegheny River supply by industrial wastes; remodeling the Berlin Water Works, Berlin, New Hampshire.

Q. Are you connected with any of the professional societies in your special vocation?

A. I am a member of the American Society of Civil Engineers, American Chemical Society, American Public Health Association, American Society of Chemical Industries, American Forestry Association, American Water Works Association, Vice-president New England Water Works Association, Boston Bacteriologists Club, Illinois Water Works Association, et cetera.

2793 Q. Have you contributed to the literature of your profession?

A. I have written several articles and taken part in several discussions before society meetings.

Q. Articles dealing with what subject?

A. The general subject of water purification and sewage disposal and the purification of inland and lit-oral waters, the disposal of factory and municipal wastes; the self-purification of streams and the removal of iron from ground water.

Q. Have you made any special line of study in the flow of ground water and its relation to public health?

A. I have. I have also testified as an expert in the case of the State of Missouri versus the State of Illinois, known as the Chicago Drainage Canal Case, and a number of other stream pollution and water works valuation cases.

Q. Are you familiar with our harbor conditions here?

A. Yes, sir.

Q. To what extent?

Mr. Riker: Excuse me a moment. What are you reading from?

The Witness: I am reading from typewritten notes prepared by myself.

Cross-examination by Mr. Riker:

Q. When were they prepared?

A. These have been prepared during the last nine months.

Q. How near the time of the inspections that you are reading about now?

A. How near the time?

Q. Yes.

A. What time do you refer to?

Q. The time that you are reading about?

A. Since July, 1911?

Q. Yes.

A. These notes are a compilation.

Q. A compilation of what?

A. Of notes taken at various times.

Q. Where are those notes?

A. They are here.

Q. You mean before you?

A. They are before me.

Q. The original notes?

A. Not the original notes; no, sir.

Q. You said that was a compilation taken from original notes. I asked you where the notes were. I knew where the compilation was. I understood that was before you. Where are the original

2794 notes?

A. The original notes *at* in various note-books in my office in Boston.

Q. Where is your office?

A. In Boston.

Q. Did you just come from there?

A. Yes, sir.

Q. Cannot you testify to the facts without having this compilation before you, from memory?
A. No, sir.

Mr. Riker: I object to the use of this compilation on the ground that the original notes should be produced to refresh his memory, if he is to use anything to refresh his memory.
The Commissioner: Note the objection of counsel for defendants.

Direct exmaination by Mr. O'Sullivan (resumed):

Q. You may proceed.
A. Have been familiar with harbor in a general way for a many years, and can remember having traversed its waters in boats and yachts as long as thirty-five years ago. I have examined it by inspection from various piers and parks. Since July, 1911, have made a point of observing sanitary character of water in East and North Rivers during frequent visits to city.
July 13, 1911. I made a tour of inspection of a portion of the Upper Bay and East River; examined particularly waters in the vicinity of outlet tunnel from Gowanus Canal, Wallabout Bay, Newtown Creek, East River as far as Clasons Point, Harlem River from Hellgate to Willis avenue bridge.
September 7, 1911. Made inspection of Upper Bay, the Narrows, paying particular attention to character of water near the vicinity of Robbins Reef and in the Kill van Kull; I examined samples of deposit dredged from bottom of Lower Bay near Narrows, and from the vicinity of Robbins Reef Light near the point mentioned in report of Passaic Valley Sewerage Commissioners for discharge of sewage.
September 6, 1911. I inspected valley of Passaic River from Newark Bay, near Lehigh Valley Railroad bridge, to the Great Falls at Paterson.
2795 Q. Have you had any experience in examining samples of water and sewage?
A. During the past seventeen years I have made several thousand examinations of samples of water and sewage. Many of these waters examined were those of streams or tidal estuaries polluted with sewage. Have also examined personally samples from the North Metropolitan Sewer of Massachusetts and believe it to closely resemble what may be expected from the Passaic Valley sewer, especially in those characteristics which are of importance from a sanitary standpoint.
Q. What is the flow of the North Metropolitan Sewer?
A. The flow in the North Metropolitan Sewer from 1904 to 1909 was as follows:

Year.	Gallons per capita per diem.
1904	121.5
1905	113.5
1906	119.4
1907	129.6
1908	119.0
1909	118.4
Average	120.2

Cross-examination by Mr. Riker:

Q. Where did you get those figures?
A. From the office of the Metropolitan Sewerage Commission.

Mr. Riker: I object to the use of the figures. If they are evidence at all, they should be proved properly.

Q. Did you have anything to do with making these figures?
A. I did not.
Q. Do you know whether they are correct?
A. I believe they are correct.
Q. I asked you whether you knew they are correct. Do you know whether they are correct?
A. I can only say I took them from the records of the Metropolitan Sewerage Commission.
Q. That is all you know about them?
A. That is all I know about them.

Mr. Riker: I object to the witness testifying to these figures on the ground that he has had nothing to do with making the records and cannot prove them.

2796 The Commissioner: Note the objections of counsel for defendants.

Direct examination by Mr. O'Sullivan (resumed):

Q. They are the official figures, are they?
A. They are, sir.
Q. How would you apply this average to the prospective discharge from the Passaic Valley trunk sewer?
A. The only change from this average figure, 120.2 gallons per capita per diem, which one might expect in the Passaic Valley is a somewhat greater proportion of manufacturing waste to total sewage, and a somewhat higher volume due to large industrial discharges. My estimate, based upon the Massachusetts data, is for a discharge of 125 gallons per capita.
Q. Did you take the question of population into consideration, and if so, state what you estimated the population of the Passaic Valley at?
A. The estimate of the Passaic Valley Sewerage Commission, as given on page 11 of their report, and that made for the year 1920 by interpolation, are as follows:

Year.		Poultation.
1911.	Estimated	702,400
1920.	Interpolated	996,400
1940.	Estimated	1,649,440

Q. Basing your estimate upon that population what would you estimate the per capita per diem sewage to be?

A. Basing my estimate upon the population just mentioned and upon a per capita per diem discharge of 125 gallons, the quantity of sewage would be as follows:

Year.	Million gallons per diem.
1920	124.5
1940	212.2

The maximum and minimum discharges will vary greatly from these averages.

Q. Have you garnered any facts relative to the composition of the sewage of the North Metropolitan District of Massachusetts?

A. The North Metropolitan District of Massachusetts furnishes sewage which aids in estimating the probable composition
2797 of sewage from the Passaic Valley.

The following are the estimates of the average composition of the Passaic Valley sewage, in grams per capita and parts per million, both at the pumping station and at Robbins Reef, assuming the volume of sewage to be 125 gallons per capita per diem, and also assuming that the sewage leaving the sedimentation basins will be septic and free from dissolved oxygen and also assuming a removal by the basins, on the average, of not over one-third of the suspended matter in the sewage and corresponding amounts of the other constituents.

Q. On these assumptions have you prepared a table estimating the average composition of the Passaic Valley sewage?

A. I have, sir.

Cross-examination by Mr. Riker:

Q. Why do you make these assumptions?

A. In order to estimate the average composition of the Passaic Valley sewage.

Q. Are the assumptions based on any facts within your own knowledge?

A. Yes, sir.

Q. Where do you get the facts on which you base your assumptions.

A. The assumed volume of 125 gallons per capita per diem I have just given as my basis of compensation of estimate.

Q. Are there any proofs in this case that have been brought to your knowledge that that assumption represents any fact?

A. As the Passaic Valley sewer does not exist, in order to estimate how much sewage may come down the sewer one must certainly make an estimate based on the performances of other sewers.

Q. Is there any other assumption based upon corresponding facts within your own knowledge?

A. The assumption that the sewage leaving the sedimentation basins will be septic is in accordance with the general effect produced by sewage of similar communities discharge from a similar sewer, serving a similar number of people, and allowing a similar time for storage before discharge.

Q. What other assumption based upon facts within your observation is there that you are using in this testimony?

2798 A. The estimates of the composition are based largely upon personal analyses of various sewages which I deem to be similar in composition to what the Passaic Valley sewage will be.

Mr. Riker: I make the further objection to this testimony on the record, Mr. Commissioner, that the testimony that the witness is offering is on the face of it based upon assumptions and hypotheses which have not been shown to exist in this case.

The Commissioner: Note the objection of counsel for defendants.

Direct examination by Mr. O'Sullivan (resumed):

Q. Proceed, Mr. Weston.

A. —.

TABLE 1.

Estimated Average Composition of Passaic Valley Sewage.

	At pumping Sta.		At outlet at Robbins Reef.	
	Grams per capita.	Parts per million.	Grams per capita.	Parts per million.
Residue on Evaporation, Suspended Matter:				
Total	120	254	80	169
Loss on Ignition	90	191	65	127
Fixed Solids	30	63	20	42
Free Ammonia	8	16.9	10	21
Organic Nitrogen	7.5	15.9	4	8.4
Oxygen Consumed:				
Total	35	74	23	49

NOTE.—Grams per capita transformed to parts per million on basis of 125 gallons of sewage per capita per day.

Regarding the possibility of removing as large a percentage of suspended matter from the sewage as the 33% just mentioned, I would give as my experience that this result could not be obtained all the time even with the flow from the Passaic Valley sewer always uniform.

The efficiency of a subsiding basis depends almost entirely upon

the velocity of currents which exist in it. I have recently
2799 constructed a series of tanks for a large corporation in Massachusetts operated at a uniform velocity of flow equivalent to less then 4 feet an hour and the percentage removal of suspended matter varied from 25% to 60%, depending upon the character of the material treated.

I am familiar with the results of the Worcester experiments made in 1902, where at a velocity of flow, varying from 8 to 27.8 feet per hour, from 31.7% to 66.3% of suspended matter was removed; also the Worcester experiments of 1908 to 1910 where at a velocity of 333 feet per hour from less than 20% to a maximum of 56.8% of suspended solids were removed.

It must be remembered, however, that the amount of iron in Worcester sewage due to the presence in the City of Worcester of wire works and other metal industries is very high, amounting, between December 1909, and November 1910, to 20% of the total suspended matter. This suspended matter would have a higher specific gravity and furthermore the iron, as it exists in Worcester sewage, is a very good precipitant. Consequently conclusions based upon Worcester data represent better efficiencies than could be hoped for in the sedimentation basins planned by the Passaic Valey Sewerage Commission, which basins are designed for a velocity of from 150 feet to 225 feet per hour.

Percentage removal of suspended matter alone is not as accurate an index of the removal of objectionable matter, as the perceptage of removal of suspended matter having a human or organic origin. Sewages from combined systems of sewers might deposit large percentages of silt or sand still be less well purified than sewages from separate systems depositing a much smaller percentage of suspended matter.

Q. Now, relative to the dissolved oxygen in sewage what is your experience as to that?

A. My experience and the results of investigations by the Mass. State Board of Health the Sanitary Research Laboratory of the Mass. Inst. of Tech. the Cities of Gloversville, N. Y., and
2800 Columbus, Ohio, all of which I am faimiliar with from personal inspection, lead me to the opinion that the sewage discharged from the Passaic Valley Sewer, at Robbins Reef, will seldom contain free dissolved oxygen. Consequently all oxydizing agencies must reside in the waters of New York Bay and its tributaries or the sewage remain in a septic and therefore offensive condition. Kinds of Sewage. At this point I might describe sewage, fresh, stale and putrid sewage. When sewage is freshly discharged from a short sewer it is a slightly turbid fluid containing besides organic and mineral matter, particles of feces, hair, paper, soap-curd and other miscellaneous debris in suspension. With the passage of time and the agitation of the sewage in the sewer, the larger particles of the suspended matter become broken up, the sewage darkens, takes on an offensive odor, and becomes, in a word, stale. If the stale sewage which contains no oxygen be aged still further (under ordinary conditions of temperature etc.) it ferments, becomes black,

putrid and stinking and gives off methane and the more offensive sulphurous gases, such as hydrogen sulphide and the gases of decomposing feces. This sewage is putrid or septic sewage. Naturally the discharge of 206,000,000 or more gallons of stale or septic sewage daily at one area must tax severely the capacity of harbor waters to dispose of it without offense. One percent of sewage mixed with sea water is always unobjectionable and such a mixture is practically saturated with oxygen. On the other hand offensive waters are rarely saturated to 50% of their capacity for dissolving oxygen.

Q. What quantity of dissolved oxygen is necessary to preserve a satisfactory condition in New York Bay?

A. About 50 per cent., sir.

Q. Have you devoted study to the tabulations that are in evidence in this case?

A. I have, sir.

Q. And marked as Complainants' Exhibits 31, 94 and these other exhibits containing oxygen plottings?

A. Yes, sir.

Q. Have you prepared any data that will represent the values of these tabulations and will sustain the answer that you have just made?

A. I have.

2801 Q. Will you state what they are?

Mr. Riker: One moment. You say you have examined certain exhibits?

The Witness: I have.

Cross-examination by Mr. Riker:

Q. When did you examine them?

A. I have examined them within twenty-four hours, and I have examined them before they were presented in evidence.

Q. You examined them before they were presented in evidence you say?

A. Yes, sir.

Q. When?

A. Well, I could not give you the dates.

Q. Well, in a general way, cannot you tell how long since it is that you examined them?

A. I think mostly since Mr. Eddy's appearance. I cannot remember the date of that.

Mr. O'Sullivan: Give the month, Mr. Weston.

The witness: I think it was the month of June.

Q. This year?

A. Yes, sir.

Q. Why do you say that was before they were presented in evidence?

A. Because they were not in evidence on the day of Mr. Eddy's appearance.

Q. You know that, do you?

A. Yes, I know that.

Q. Now, what did you examine?

A. I examined the data relative to the amount of dissolved oxygen contained in the waters of New York Bay and its tributaries.

Q. What exhibits were those?

A. These numbers—I have not a record of the numbers. They lie on the table there.

Q. How do you know that you examined the ones that you are testifying to?

A. How do I know?

Q. Yes.

A. I have seen them in Doctor O'Sullivans' office.

Q. Is that the only way you have of identifying them?

A. They are marked with exhibit numbers so and so. I cannot remember the numbers.

Q. How long a time did you devote to the examination of
2802 these exhibits?

A. The examination of these exhibits themselves, very little time. To a copy of them, a great deal of time.

Q. How do you know that what you examined was a copy of them?

A. I have been over both copies and I am pretty sure that they are comparable, one with the other.

Q. You started to say that you compared them?

A. I have not compared every figure.

Q. What comparison have you made?

A. I have read over, in the first place, the blue-print of a tracing, and they are naturally duplicates, and being alike in one or two particulars, they would be alike in all particulars, and I am familiar enough with one by simple inspection of the other to assure myself absolutely that I have been using the same data.

Q. Now, in saying that you are assuming, are you not, that the blue-print that you had was taken from the same tracing that the blue-print which you saw in Doctor O'Sullivan's office was taken from?

A. Yes, I am assuming it; in fact I know it.

Q. How do you know it ?

A. I could detect a counterfeit.

Q. And the data which you have before you now, which you are about to read into the evidence, is made up from the copies which were furnished you?

A. The actual studies from the copy.

Q. Yes.

A. They were; yes sir.

Mr. Riker: I object to the use of this paper, as it does not appear to be based on any evidence in this case, so far as this witness is able to state.

The Commissioner: Note the objection of counsel for defendants.

Direct examination by Mr. O'Sullivan (resumed):

Q. Mr. Weston, have you had copies of Complainants' Exhibits Nos. 31 and 94, showing the oxygen tabulations for the years 1909 and 1911?

A. I have.

Q. Have you had them for some months in Boston?

A. Yes sir.

2803 Mr. Riker: Are those the copies that you have been testifying to in answer to my questions?

The Witness: The same; yes sir.

Mr. Riker: And your knowledge of their being copies is no greater now than it was when I asked you about it, is it?

The Witness: The same.

Mr. Riker: The objection is renewed.

The Commissioner: Note the objection of counsel for defendants.

By Mr. O'Sullivan:

Q. You may proceed, Mr. Weston.

A. The result of the first tabulation were plotted under my direction and afterward verified by me, and are shown on this blue-print which I call Figure Number 1.

(Witness produces blue-print.)

A. (Continuing:) And which has to do with experiments made by the Metropolitan Sewerage Commission on September 26, 1911, samples being taken at five points. The following data compiled from tests made by the Metropolitan Sewerage Commission of New York which is included in exhibits in this case are useful in forming an opinion regarding the relation between objectionable conditions and the dissolved oxygen content.

Complete tests of dissolved oxygen in water made by Metropolitan Sewerage Commission September 26, 1911, samples being taken at 5 points—200 feet off Fort Lafayette, ¼ way across, ½ way across, ¾ way across and 200 feet off Fort Wadsworth—at 3 depths—1 foot below surface 20 to 40 feet below surface, 60 to 80 feet below surface.

Tests began 6.30 a. m., continued to 6.36 p. m. 7 runs. Each run began at half after even hour, except last run which began at 6 p. m. First sample of each run taken from surface, 200 feet off Fort Lafayette, 2 minutes later sample taken at mid-depth and 2 minutes later at bottom depth; all at same location. 5 minutes after the last sample, the surface sample was taken at the second sampling point, one-quarter way across from Fort Lafayette, 2 minutes later

2804 the mid-depth sample, 2 minutes later the bottom depth sample. After an interval of 5 minutes, the surface sample one-half way across was taken, 2 minutes later the mid-depth sample and 2 minutes later the bottom depth sample. This same system of sampling was continued at the point three-quarters way across Narrows and at point 200 feet off Fort Wadsworth. The sampling on this run ceased at 7.10, a period of 1 hour 20 minutes elapsing between completion of the run and beginning of the next run, in each

case except the last, when the period between runs was but 50 minutes. In last run interval of time between the taking of the samples at each station was 4 minutes.

Cross-examination by Mr. Riker:

Q. You are testifying now from your own observation?
A. I am repeating data compiled from the exhibits.
Q. You are not testifying from anything that is within your own personal knowledge?
A. I am testifying about conditions already in evidence.
Q. I know, but are you testifying to anything that you know of your own knowledge, from your own observation?
A. My own personal observation?
Q. If you prefer to put the word personal in the question, yes?
A. I am presenting a compilation of data.
Q. Cannot you answer my question, Mr. Weston, whether your testimony is based on your own personal observation?
A. Of this experiment?
Q. Yes.
A. No.

Mr. Riker: I desire to give notice of motion to strike out the testimony of this witness in which he states certain things as fact, which things it now appears were not within his own knowledge at all.
The Commissioner: Note the motion of counsel for defendants.

Direct examination by Mr. O'Sullivan (resumed):

Q. You may proceed, Mr. Weston.

Mr. Riker: The same objection to this, and the same motion.
The Commissioner: Note the objection and motion of counsel for defendants.

2805 A. Temperatures were same at all sampling points and at all depths, being 20° C. = 68° F.
Per cent. land water and oxygen required to saturate the water varied as follows:

Surface, flood	26% — 30%,	5.65 c. c. — 5.7 c. c.
" ebb	26% — 30%,	5.65 c. c. — 5.7 c. c.
Below surface, flood	20% — 28%,	5.5 c. c. — 5.7 c. c.
" surface, ebb	20% — 28%,	5.5 c. c. — 5.7 c. c.

Dissolved Oxygen—Surface:

Minimum, 3.69 c. c. = 65% Flood (slack) and Ebb.
Maximum, 5.00 " " = 89% End of flood.
Average flood samples, forenoon = 80%.
" ebb = 77.6%.
" all flood samples = 81.9%.
" all samples = 77% (35 samples—ebb and flood).

Dissolved Oxygen—Below Surface:

Minimum, 3.83 c. c. = 68% Flood (slack) and Ebb.
Maximum, 5.04 c. c. = 91% End of flood, and Flood.
Average, 79% (70 samples, ebb and flood).

Average Dissolved Oxygen entire run, all depths, 78.6% (105 samples ebb and flood).

Dissolved Oxygen—Surface Samples—Average of each run:

6.30— 7.10	A. M.	67%	Flood (slack).
8.30— 9.10	" "	85%	"
10.30—11.10	" "	88%	"
12.30— 1.10	P. M.	85%	Ebb.
2.30— 3.10	" "	77%	"
4.30— 5.10	" "	71%	"
6.00— 6.30	" "	67%	"

Dissolved Oxygen—Below Surface—Average of each run (middle and bottom samples):

6.30— 7.10	A. M.	69%	Flood (slack).
8.30— 9.10	" "	90%	"
10.30—11.10	" "	90%	"
12.30— 1.10	" "	88%	Ebb.
2.30— 3.10	" "	78%	"
4.30— 5.10	" "	71%	"
6.00— 6.36	" "	70%	"

These tests show that the dissolved oxygen did not rise
2806 above 91% and did not fall below 65% on individual tests.

The lowest average of surface samples on a single run was 67%, which occurred at approximately the same stage of tide at both night and morning. The highest average for any run was 88%.

The lowest average of mid-depth and bottom samples on single run, was 69%, while the highest was 90%. The dissolved oxygen at practically the same stage of the tide, at night and morning, was 69% and 70 respectively.

There is very little difference between the dissolved oxygen content in the samples taken below the surface and those taken at the surface. The difference, based upon averages of each run, ranged from 0 to 5%, the average of all samples below the surface was 79%, while the average of all samples, including surface, mid-depth and bottom samples, was 78.6%.

The variation in the oxygen content, in samples taken at different points across the Narrows, was relatively slight, being about 2%.

Q. Did you cause to be plotted upon a chart or map any curves or figures that would indicate the fluctuations that you have just testified to?

A. I have, sir.

Mr. O'Sullivan: I offer this chart or map made by this witness, described as dissolved oxygen, cross-section at the Narrows, Septem-

ber 26, 1911, and ask that it be marked Complainants' Exhibit No. 159.

Cross-examination by Mr. Riker:

Q. Now, Mr. Weston, this is a graphic illustration of certain facts which you deduced from the testimony that is already in this case, as you understand it?

A. Yes, sir.

Q. It is not based upon any observations made by you personally?

A. No.

Q. And of your own knowledge you know nothing whatever as to that accuracy of the data upon which you have based this graphic representation, do you?

A. No, sir.

Q. This is an assumption by you that the data are correct as furnished to you?

2807

A. Yes.

Q. And this is a draftsman's representation by curves of the results of your consideration of the data?

A. It is a draftman's representation of the testimony just previously given, that is the figures given.

Q. Where is the original?

A. The original is in my office in Boston.

Q. Did you make this blue-print?

A. I saw it made; yes, sir.

Q. And you know it was made from the original?

A. Yes.

Q. Have you compared it?

A. I do not have to, I saw it made.

Q. I did not ask you whether you had to. I asked you whether you did. Did you?

A. No; I did not.

Q. Why do not you produce the original; cannot you?

A. It is my general practice to keep the original of all data in the office.

Q. Who did the original drafting?

A. One of my assistants.

Q. Under your direction?

A. Yes, sir.

Q. In what did your direction consist?

A. I gave him the figures and told him to make the graphic representation of those figures. I afterwards compared his draft with the figures and signed the tracing for identification.

Mr. Riker: The offer is objected to on the ground that it is not the original in the first place, and in the second place the original was not produced by the witness, and in the third place because it is based on assumptions which are not facts in the case.

The Commissioner: Note the objection of counsel for defendants. Received and marked Complainants' Exhibit No. 159.

Marked Complainants' Exhibit No. 159.

Direct examination by Mr. O'Sullivan (resumed):

Q. Mr. Weston, in the chart of graphic representation that has just been offered in evidence I see a signature under the line June 21, 1912. I ask you whose signature that is?

A. That is mine.

Q. Where was that signature made?

A. It was made on the original tracing of June 21, 1912.

2808 Q. Is that your handwriting, duplicated in that fashion?

A. Yes, sir.

Q. Is there any doubt about that?

A. No, sir.

Q. Taking these tabulations and your studies thereon and your interpretation thereof, what conditions of the water did you find in the upper New York Bay near Robbins Reef Light, as shown by these oxygen tests?

A. Extended tests of dissolved oxygen were made, by the Metropolitan Sewerage Commission, in upper New York Bay, in the vicinity of Robbins Reef Light, October 16, 23 and 24, 1911.

Test Made October 16, 1911.

Samples were taken at 3 points—one-half mile northeast of Robbins Reef Light, one-half mile east southeast of Robbins Reef Light, and one-half mile south of Robbins Reef Light. 3 depths—1 foot below surface, 20 to 25 feet below surface, 40 to 50 feet below surface.

Tests began at 9.20 A. M., and ended at 5.30 P. M.—5 runs. Runs began at 9.20 and 11.20 A. M., 1.20, 3.20, and 5.10 P. M. There was an interval of about 2 minutes between samples taken in a vertical line at each station, and a 10-minute interval between the bottom sample at one station and the surface sample at the next station.

Temperatures varied from 16° to 16½° C. = 60.8° to 61. 7° F.

Per cent. land water and oxygen required to saturate the water varied as follows:

Surface, flood	28% — 42%,	6.1 c. c. — 6.2 c. c.
" ebb	36% — 44%,	6.1 c. c. — 6.3 c. c.
Below Surface, flood	20% — 32%,	6.0 c. c. — 6.1 c. c.
Below Surface, ebb	32%	6.1 c. c.

Dissolved Oxygen—surface:

Minimum, 3.96 c. c. = 64% Ebb.
Maximum, 4.65 c. c. = 77% Flood.
Average, = 70%

Dissolved Oxygen—Below Surface:

Minimum, 3.96 c. c. = 65% Flood and Ebb.
Maximum, 4.68 c. c. = 79% Flood.
Average, 4.65 = 73%.

2809 Average of Dissolved Oxygen entire runs, all depths = 72%.

Dissolved Oxygen—Surface Samples—Average of each run:

9.20 A. M.—	9.55 A. M.	64%	Ebb.
11.20 " " —	11.55 " "	66%	End of Ebb.
1.20 P. M.—	1.55 P. M.	69%	Flood.
3.20 " " —	3.55 " "	76%	"
5.10 " " —	5.30 " "	76%	"

Dissolved Oxygen—Below Surface—Average of each run:

9.20 A. M.—	9.55 A. M.	67%	Ebb.
11.20 " " —	11.55 " "	66%	End of Ebb.
1.20 P. M.—	1.55 P. M.	76%	Flood.
3.20 " " —	3.55 " "	76%	"
5.10 " " —	5.30 " "	79%	"

These tests show that the dissolved oxygen, in individual tests, did not rise above 79% and did not fall below 64%.

The lowest average of surface samples on any run was 64%, while the highest was 76%. The lowest average on samples taken below surface on any run was 67%, the highest 79%.

The difference between surface and bottom samples, on the average, ranged from 0 to 6%.

Test Made October 23, 1911.

Samples were taken at 5 points—500 ft. E. of Buoy G2 (1 mile N. of Robbins Reef Light, 1 mile E. So. E. of Robbins Reef Light, 1 mile S. So. E. of Robbins Reef Light, ¼ mile S. of E. of Robbins Reef Light,—at 3 depths—1 ft. below surface, 15 to 40 ft. below surface, 30 to 80 ft. below surface. In making up the following figures the station at the Narrows has been omitted from consideration.

Tests began at 9.30 A. M. and ended at 4.50 P. M.—3 runs—9.30 A. M., 12.30 and 3.30 P. M. Samples in a vertical line, at each station, were taken at intervals of 2 minutes, and there was an interval of 10 to 25 minutes between the taking of the bottom sample at one station and the taking of surface sample at the next.

Temperature at all stations, all depths, was 16° C. = 60.8° F.

Per cent. land water and oxygen required to saturate the water varied as follows:

2810

Surface, flood	40% to 62%	6.3 c. c. — 6.5 c. c.
" ebb	52% to 74%	6.4 c. c. — 6.6 c. c.
Below Surface, flood	30% to 34%	6.1 c. c. — 6.1 c. c.
ebb	36% to 58%	6.1 c. c. — 6.4 c. c.

Dissolved Oxygen—Surface:

Minimum,	4.10 c. c. = 65%	Ebb.
Maximum,	4.92 c. c. = 78%	Flood.
Average,	= 72%.	

Dissolved Oxygen—Below Surface:

Minimum, 4.10 c. c. = 66% Ebb.
Maximum, 4.92 c. c. = 81% Flood.
Average, = 73%.

Average Dissolved Oxygen entire runs, all depths, = 74%.

Dissolved Oxygen—Surface Samples—Average of each run:

9.30 A. M.—10.50 A. M. 76% Flood.
12.30 " " — 1.50 " " 71% Ebb.
3.30 " " — 4.50 " " 69% Ebb.

Dissolved Oxygen—Below Surface—Average of each run:

9.30 A. M.—10.50 A. M. 78% Flood.
12.30 P. M.— 1.50 P. M. 72% Ebb.
3.30 " " — 4.50 " " 69% Ebb.

Note that there are only 3 runs, 2 of which were on the ebb tide.

These tests show that the dissolved oxygen, in individual tests, did not rise above 81% nor fall below 65%.

The lowest average of surface samples, on a single run, is 69%, the highest 76%.

The lowest average of mid-depth and bottom samples, is 69%, the highest 78%.

The difference between the top and bottom samples, on the average, was not over 2%.

Test Made October 24, 1911.

Samples were taken at 5 points—¼ mile S. of E. of Robbins Reef Light, ¼ mile So. E. of Robbins Reef Light, ¼ mile So. of Robbins Reef Light, near Spar Buoy A off Tompkinsville—at 3 depths—1 ft. below surface, 10 to 40 ft. below surface, 20 to 80 ft. below surface.

The station at the Narrows has been omitted from consider-
2811 ation in making up the following figures.

Tests began at 9.45 A. M. and ended at 4.55 P. M.—3 runs—9.45 A. M., 12.45 P. M. and 3.45 P. M. Samples were taken in general 3 minutes apart in a vertical line, and with an interval of from 9 to 24 minutes between bottom sample at one station and surface sample at the next.

Temperatures varied from 15½ to 16° C. = 59.9 to 60.8° F.

Per cent. land water and oxygen required to saturate the water varied as follows:

Surface, flood	46% — 52%,	6.3 c. c. — 6.4 c. c.
" ebb	54% — 68%,	6.4 c. c. — 6.5 c. c.
Below surface, flood	34% — 44%,	6.1 c. c. — 6.3 c. c.
Below surface, ebb	40% — 52%,	6.2 c. c. — 6.4 c. c.

Dissolved Oxygen—Surface:

Minimum, 4.65 c. c. = 72% Flood.
Maximum, 5.22 c. c. = 82% Ebb.
Average, = 77% Flood.

Dissolved Oxygen—Below Surface:

Minimum, 4.38 c. c. = 68%.
Maximum,
{5.22 c. c. = 83%}
{5.36 c. c. = 83%} Ebb.
Average, = 78%.

Q. Have you computed the average of dissolved oxygen for entire runs at all depths?
A. Yes, sir; 78 per cent.

Dissolved Oxygen—Surface Samples—Average of each run:

9.45 A. M.—11.06 A.M. 74% Flood.
12.45 P. M.— 2.06 P. M. 79% Ebb.
3.45 " " — 4.55 " " 79% "

2812

Dissolved Oxygen—Below Surface—Average of each run:

9.45 A. M.—11.06 A. M. 72% Flood.
12.45 P. M.— 2.06 P. M. 81% Ebb.
3.45 " " — 4.55 " " 81% Ebb.

Note that there are only 3 runs, two of which were on the ebb tide. In these tests the dissolved oxygen did not rise above 83%, or fall below 68%, on individual tests.

The lowest average of surface samples, on a single run, was 74%, the highest 79%. The lowest average on samples taken below the surface, was 72%, the highest 81%.

Q. Did you cause any chart or map to be prepared of the matters just testified to?
A. I prepared a map which I called Figure 2.
Q. Did you sign the original of that blue-print or chart or map?
A. I did.
Q. Is your signature reproduced in the copy that you have now?
A. It is.

Mr. O'Sullivan: I offer that in evidence and ask that it be marked Complainants' Exhibit No. 160.

Cross-examination by Mr. Riker:

Q. Mr. Weston, the matters that you have testified to just preceding the offer of this chart, are they matters within your own knowledge?
A. The data are not within my own personal knowledge.
Q. Is any part of the data?

A. Simply the compilation and arrangement of them; that is within my own knowledge.

Q. The making of the averages you mean?

A. Yes.

Q. And that is a mathematical process, is it not, based on the figures furnished you from some other sources?

A. Yes.

Q. And this chart is based upon those averages that you have testified to, being made from data furnished to you?

A. It is.

Q. And this chart is a blue-print of the tracing that you have in your office?

A. Yes.

2813 Q. And you do not produce it for the same reason that you did not produce the other tracing, the last exhibit?

A. Yes.

Q. Did you make the original tracing from which this is a blue-print?

A. No.

Q. Was that made in the same way as the last exhibit?

A. Yes.

Mr. Riker: The offer is objected to on the same grounds as the last exhibit.

The Commissioner: Note the objection of counsel for defendants. Received and marked Complainants' Exhibit No. 160.

Received and marked Complainants' Exhibit No. 160.

Direct examination by Mr. O'Sullivan (resumed):

In addition to what you have testified to, Mr. Weston, have you undertaken to interpret from the exhibits already in evidence to which your attention has already been called, the condition of the waters of the East River at a cross-section?

A. I have.

Q. Taken from where in the East River, what part of it?

A. Cross-section from Pier 10 in Manhattan to Pier 10 in Brooklyn, as shown by dissolved oxygen tests made by the Metropolitan Sewerage Commission.

Complete tests of dissolved oxygen in water made by Metropolitan Sewerage Commission September 29, 1911, samples being taken at 5 points—100 ft. off Pier 10 Manhattan, ¼ way across, ½ way across, ¾ way across, and 100 ft. off Pier 10 Brooklyn—at 3 depth, 1 ft. below surface, 20 ft. below surface, and 30 to 40 ft. below surface.

Tests began at 7.30 A. M. and ended at 6.30 P. M.—6 runs. The runs began at 7.30 and 9.30 A. M., and 12.30, 2.30, 4.30 and 6 P. M. The first sample of each run was taken from the surface 100 ft. off Pier 10 Manhattan. 2 minutes later sample was taken at mid-depth, and 2 minutes later at bottom depth, all at the same location. After an interval of 4 minutes a sample was taken ¼ way across from Pier 10 Manhattan, 2 minutes later one at mid-depth, and 2 minutes

later the bottom sample. This system of sampling was con-
2814 tinued at the point ½ way across and at that ¾ way across from Pier 10 Manhattan, and at 100 ft. off Pier 10 Brooklyn. The sampling on this first run ceased at 8.06 A. M. The other 5 runs were carried on according to this same schedule.

Temperature of all samples 20° C. = 68° F.

Per cent. land water and oxygen required to saturate the water varied as follows:

Surface, food	28% to 34%,	5.7 c. c.
" ebb	28% to 32%,	5.7 c. c.
Below surface, flood	28% to 30%,	5.7 c. c.
Below surface, ebb	28%	5.7 c. c.

Dissolved Oxygen—Surface:

Minimum,
{2.87 c. c. = 51% Ebb 7.32, Flood 10.04 A. M.
{2.92 Ebb 7.32, 6.01 P. M.

Maximum, 3.36 c. c. = 60% {Flood 12.42 P. M.
{Flood 2.40 P. M.

Average, = 55%.

Average Dissolved Oxygen entire run, all depths, 54%.

Dissolved Oxygen—Surface Samples—Average of each run:

7.30 A. M.	8.06 A. M.	49%	Ebb.
9.30 " "	10.06 " "	33%	Flood.
12.30 P. M.	1.09 P. M.	56%.	
2.30 " "	3.06 " "	58%.	
4.30 " "	5.06 " "	52%	Ebb.
6.00 " "	6.30 " "	51%	" .

Dissolved Oxygen Below Surface—Average of each run (middle and bottom samples):

7.30 A. M.	8.06 A. M.	52%	Ebb.
9.30 " "	10.06 " "	55%	Flood.
12.30 P. M.	1.09 P. M.	58%	"
2.30 " "	3.06 " "	58%	"
4.30 " "	5.06 " "	54%	Ebb.
6.00 " "	6.30 " "	52%	"

2815 These tests show that the dissolved oxygen did not rise above 60% and did not fall below 48% on individual tests. The lowest average of surface samples, on a single run, was 49%, the highest average for any run being 58%.

The lowest average of mid-depth and bottom samples, on a single run, was 52%, while the highest was 58%.

The difference between the dissolved oxygen content of the bottom, mid-depth, and surface samples, taken as an average of each run, ranged from 0 to 3%.

The averages of dissolved oxygen in the surface samples at the 5 stations across the river, showed that on both the Manhattan and

Brooklyn sides the dissolved oxygen amounted to 52%, whereas in the middle of the river it was 56%.

Q. Have you prepared any graphic chart or map showing the data that you have just testified to?

A. I have.

Q. Did you sign it?

A. I did.

Q. Is the signature reproduced on the copy that you now produce?

A. Yes, sir.

Mr. O'Sullivan: I offer in evidence the graphic chart produced by this witness, purporting to give a cross-section of the East River, and ask that it be marked Complainants' Exhibit No. 161.

Cross-examination by Mr. Riker:

Q. When you say, Mr. Weston, that certain things were done by way of getting data you do not mean that you know that they were done, do you?

A. I mean that the records of the Metropolitan Sewerage Commission state that they were done.

Q. That is what you mean in that case?

A. Yes.

Q. And this chart is based upon an acceptance by you of certain data not obtained by yourself?

A. That is correct.

Q. And this chart is prepared in the same way as the last chart that you produced?

A. Exactly.

2816 Mr. Riker: This offer is objected to on the same grounds as the last offer, the last chart.

The Commissioner: Note the objection of counsel for defendants.

Received and marked Complainants' Exhibit No. 161.

Marked Complainants' Exhibit No. 161.

Direct examination by Mr. O'Sullivan (resumed):

Q. Have you undertaken to interpret the conditions of the water in the East River at any other point than the one that you have testified to?

A. Yes, sir, a cross-section between Lawrence Point and Stony Point.

Complete tests of dissolved oxygen in water, made by Metropolitan Sewerage Commission, October 11, 1911, samples being taken at 3 points—by Buoy 7 near Lawrence Point, ½ way across, and 200 ft. off E. 134th St. Ferry.—at 3 depths—1 ft. below surface, 20 to 35 ft. below surface, and 40 to 70 ft. below surface.

Tests began at 7.50 A. M. and ended at 5.20 P. M.—6 runs. Runs began at 7.50, 10, 12, and at 2, 4, and 5. In general the regular schedule was followed, of 2 minutes between samples taken in vertical line, and 4 minutes between stations.

Temperatures at surface varied from 16° — 16.5° C. = 60.8° — 61.7° F.

Per cent. land water and oxygen required to saturate the water varied as follows:

Surface, Flood..... 26% — 35% = 6.0 c. c. — 6.1 c. c.
" Ebb ..... 24% — 28% = 6.0 c. c. — 6.1 c. c.

Below Surface:

Flood ..... 26% — 32 = 6.0 c. c. — 6.1 c. c.
Ebb ..... 24% — 28% = 6.0 c. c. — 6.1 c. c.

Dissolved Oxygen—Surface:

Minimum, 3.14 c. c. = 51% Flood.
(3.19)
Maximum, 3.70 c. c. = 62% Ebb.
Average = 56%

2817 Dissolved Oxygen—Below Surface:

Minimum, 3.28 c. c. = 54% Flood and Ebb.
Maximum, 3.84 c. c. = 64% Ebb.
Average = 57.8%.

Average of all Samples, Dissolved Oxygen, entire run, all depths = 57.0%.

Dissolved Oxygen—Surface Samples—Average of each run:

7.50 A. M. — 8.10 A. M. 55% Flood.
10.00 " " — 10.20 " " 52% "
12.00 Noon — 12.20 P. M. 51% "
2.00 P. M. — 2.20 " " 54% Ebb.
4.00 " " — 4.20 " " 60% "
5.00 " " — 5.20 " " 60% "

Dissolved Oxygen—Below Surface—Average of each run:

7.50 A. M. — 8.10 A. M. 55% Flood.
10.00 " " — 10.20 " " 55% "
12.00 Noon — 12.20 " " 55% "
2.00 P. M. — 2.20 P. M. 55% Ebb.
4.00 " " — 4.20 " " 63% "
5.00 " " — 5.20 " " 63% "

These tests show that the dissolved oxygen did not rise above 64% and did not fall below 51%. The average of the surface sample in each run ranged from 51 to 60%, and the bottom sample from 55 to 63%.

The difference between per cent. of saturation in the surface, mid-depth, and bottom samples, ranged from 0 to 4%. The average of the surface samples taken at each station across the river, varied only slightly.

Q. Did you cause the data that you have just embodied in your testimony to be put in graphic form?

A. I did.
Q. Have you got the chart or map in which that data appears?
A. I have, it is called Figure 4.
Q. Did you sign the chart or map, the original?
A. I did, sir.
2818 Q. Does your signature appear in this copy that you produce?
A. It does.

Mr. O'Sullivan: I offer the chart of the cross-section of the East River for October, 1911, as testified to by this witness; I offer this graphic representation of that cross-section in evidence, and ask that it be marked Complainants' Exhibit No. 162.

Cross-examination by Mr. Riker:

Q. How far is this from the proposed point of discharge of the Passaic Valley sewer?
A. About 18 miles, if this scale is correct.
Q. From the proposed point of discharge?
A. Yes sir.
Q. And do you know in which direction with reference to the proposed point of discharge the waters at the point of the cross-section flow?
A. They flow both ways.
Q. They do?
A. Yes, back and forth.
Q. That is the result of your own observation, is it?
A. Yes, sir.
Q. Now, this graphic representation by way of a chart, which is now offered, is based upon the same kind of data as the last one, as the last chart that was presented?
A. Yes, sir.
Q. And the original was made in the same way?
A. Yes.
Q. And the blue-print was made in the same way?
A. Yes.
Mr. Riker: The offer is objected to on the grounds against the last offer, and also on the ground that it appears that this cross-section is 18 miles from the point of discharge, and it has not yet been made to appear that it has any relevancy to the issue in this case.
The Commissioner: Note the objection of counsel for defendants.
Received and marked Complainants' Exhibit No. 162.
Marked Complainants' Exhibit No. 162.

Direct examination by Mr. O'Sullivan (resumed):

Q. Mr. Weston, do the waters from the point that you have
2819 just described as Lawrence and Stony Point, do the waters between these two points enter on the ebb New York Upper Bay?
A. Yes.

Q. Taking the data in the exhibits to which your attention has been directed and to which you have testified, did you take into consideration any other cross-section of the East River at any other points?

A. I took into consideration a cross-section between Throgs Neck and Willetts Point.

Q. What did the dissolved oxygen tests show for that cross-section?

A. Complete tests of dissolved oxygen in water made by Metropolitan Sewerage Commission, October 25, 1911, samples being taken at 3 points—¼ way across, ½ way across, and ¾ way across—at 3 depths—1 ft. below surface, 30 to 40 ft. below surface, and 60 to 80 ft. Below surface.

Tests began at 7.30 A. M. and continued until 5.30 P. M.—6 runs. The runs began at 7.30, 9.30, and 11.30 A. M., and 1.30, 3.30, and 5 P. M. In general a 2 minute interval elapsed between the taking of the surface and mid-depth samples, and a 3 minute interval between the mid-depth and bottom sample. There was an interval of 7 to 8 minutes between the taking of the bottom sample at one station and the taking of the surface sample at the next.

Temperature varied at surface from 15° to 16° C. = 59° to 60.8° F.; below surface from 14.5° to 16° C. = 58.1 to 60.8 F.

Per cent. land water and oxygen required to saturate the water varied as follows:

Surface, flood	24%	= 6.0 c. c.
ebb	24% — 26%	= 6.0 c. c.
Below surface, flood	22% — 24%	= 6.0 c. c.
Below surface, ebb	24% — 26%	= 6.0 c. c.

Dissolved Oxygen—Surface:

Minimum, 4.78 c. c. = 71% Ebb.
Maximum, 5.46 c. c. = 90% Flood.
Average = 81.9% (18 samples).

2820 Dissolved Oxygen—Below Surface:

Minimum, 4.94 c. c. = 79% Ebb.
Maximum, 5.74 c. c. = 94% Flood.
Average, = 87.2% (36 samples).

Average Dissolved Oxygen entire run, all depths, 86.4% (54 samples.

Dissolved Oxygen—Surface Samples—Average of each run:

7.30 A. M.	— 8.00 A. M.	72% Ebb.
9.30 " "	— 10.00 " "	78% Flood.
10.30 " "	— 12.00 Noon	89% "
1.30 P. M.	— 2.00 P. M.	89% "
3.30 " "	— 4.00 " "	86% Ebb.
5.00 " "	— 5.30 " "	77% "

Dissolved Oxygen—Below Surface—Average of each run:

7.30 A. M. —	8.00 A. M.	80%	Ebb.
9.30 " " —	10.00 " "	89%	Flood.
11.30 " " —	12.00 Noon	89%	"
1.30 P. M. —	2.00 P. M.	93%	"
3.30 " " —	4.00 " "	86%	Ebb.
5.00 " " —	5.30 " "	86%	"

These tests show that the dissolved oxygen ranged from maximum of 94% to a minimum of 71%.

The average of the surface samples taken on each run, ranged from 72% to 89%. On samples mid-depth and bottom the range was from 80% to 93%.

The difference in the amount of saturation between surface, mid-depth, and bottom samples ranged, on the average, from 0 to 11%. The average of surface samples taken at each station across the river, showed a regular increase in per cent. of saturation, from Throgs Neck to Willet Point.

Q. Did you cause the data you have just testified to to be put in graphic form, Mr. Weston?

A. I did, sir.

2821 Q. Did you sign the original?

A. I signed the original and called it Figure 5.

Q. Does your signature appear in the copy made by you on the original?

A. It does.

Mr. O'Sullivan: I offer this chart of the cross-section of the East River, from Throgs Neck to Willetts Point, just described by this witness, October 25, 1911, I offer it in evidence and ask that it be marked Complainants' Exhibit No. 163.

Cross-examination by Mr. Riker:

Q. Mr. Weston, how far is this cross-section from the point of the proposed discharge of the Passaic Valley sewer?

A. Would you like the exact distance, sir.

Q. No, not the exact distance; give us the approximate distance?

A. About 17 miles, sir.

Q. It is nearer than the last cross-section?

A. I think the scale on the last map must have been in error. I would like to correct that if I might.

Q. Yes.

A. 10¾ miles, roughly, the first distance.

Q. The second distance is roughly 17 miles?

A. Yes, sir.

Q. And the data upon which this last exhibit is based was furnished to you in the same way as for the preceding exhibit?

A. Yes.

Q. And the original was made in the same general way as this exhibit?

A. Yes.

Mr. Riker: The offer is objected to for the same reasons.

The Commissioner: Note the objection of counsel for defendants. Received and marked Complainants' Exhibit No. 163.

Marked Complainants' Exhibit No. 163.

Direct examination by Mr. O'Sullivan (resumed):

Q. Mr. Weston, did you undertake to determine the condition of the water in the Hudson River by a cross-section?

A. I did.

2822 Q. At what points?

A. Along a line from Pier A to Central Railroad of New Jersey Ferry. Complete tests of dissolved oxygen in water made by Metropolitan Sewerage Commission, September 28, 1911, samples being taken at 5 points—200 ft. off Pier A, ¼ way across, ½ way across, ¾ way across, and 200 ft. off Jersey Central Ferry—at 3 depths—1 ft. below surface, 15 to 20 ft. below surface, 25 to 40 ft. below surface.

Tests began at 6.30 A. M. and ended at 6.30 P. M.—7 runs. Each run began one-half after even hour, except last one which began at 6 P. M. Samples at each station were taken with 2 minute interval between surface, mid-depth, and bottom and there was an interval of about 5 minutes between the bottom sample at one station and the surface sample at the next station.

Temperature was 20° C. = 68° F. for all samples, all depths.

Per cent. land water and oxygen required to saturate the water varied as follows:

Surface, flood	32% — 42% = 5.7 c. c. — 5.8 c. c.	
" ebb	32% — 46% = 5.7 c. c. — 5.8 c. c.	
Below surface, flood	28% — 38% = 5.7 c. c. — 5.8 c. c.	
Below surface, ebb	28% — 42% = 5.7 c. c. — 5.8 c. c.	

Dissolved Oxygen, Surface:

Minimum,	2.73 c. c. — 47%	8.30 A. M. Ebb.
	2.73 c. c. — 47%	6.30 P. M. End of Ebb.
Maximum,	3.48 c. c. — 61%	2.57 P. M. Flood.
Average,	— 54%	(35 samples).

Dissolved Oxygen—Below Surface:

Minimum,	2.92 c. c. — 51%	occurred 3 times, Ebb tide.
Maximum,	3.48 c. c. — 64%	Flood.
Average.	— 56%	(70 samples).

Average Dissolved Oxygen entire run, all depths, 55%.

2823 Dissolved Oxygen—Surface Samples—Average of each run:

6.30 A. M.	— 7.10 A. M.	53%	Ebb.
8.30 " "	— 9.10 " "	50%	"
10.30 " "	— 11.10 " "	53%	Flood.
12.30 " "	— 1.10 " "	56%	"
2.30 " "	— 3.10 " "	60%	"
4.30 " "	— 5.10 " "	54%	Ebb.
6.00 " "	— 6.30 " "	50%	"

Dissolved Oxygen—Below Surface—Average of each run (middle and bottom):

6.30 A. M.	— 7.10 A. M.	54%	Ebb.
8.30 " "	— 9.10 " "	52%	"
10.30 " "	— 1.10 " "	55%	Flood.
12.30 P. M.	— 1.10 P. M.	59%	"
2.30 " "	— 3.10 " "	62%	"
4.30 " "	— 5.10 " "	57%	Ebb.
6.00 " "	— 6.30 " "	52%	"

These tests show that the dissolved oxygen did not rise above 64% or fall below 47% on individual tests. The lowest average of surface samples, on single run, was 50%, while the highest was 60%. On samples below surface the lowest average was 52% and the highest 62%.

The difference between the amount of dissolved oxygen in the surface, mid-depth, and bottom samples, taking the averages of each run, varied from 1% to 3% saturation. In every case the mid-depth and bottom samples were higher in dissolved oxygen than the surface samples.

An average of the surface samples taken at each station in the cross-section, showed but slight variation; the per cent. of saturation for the stations ½ to ¾ way across from the New York side being slightly higher than at the stations 200 feet from the New York side and 200 feet from the New Jersey side.

2824 Q. Have you got a chart or map graphically depicting the facts just testified to?

A. I have, sir.

Q. Did you sign the original?

A. I did, and called it Figure 6.

Q. Do you find reproduced your signature in your own handwriting here?

A. I do.

Q. And can you identify it as such?

A. I can.

Mr. O'Sullivan: I offer the chart or map described by this witness as Figure 6, purporting to give a cross-section of the Hudson River for September 28, 1911, showing the dissolved oxygen content thereof. I offer it in evidence and ask that it be marked Complainants' Exhibit No. 164.

Cross-examination by Mr. Riker:

Q. Mr. Weston, is there any fact embodied in this chart which is not already in evidence, as you understand it, in the case?

A. No.

Q. And does this chart represent, so far as you are able to make it represent, all the facts that are shown by the exhibit dealing with the oxygen contents at the point involved in this chart?

A. Yes.

Q. This is then nothing more nor less than a graphic representa-

tion of facts which you understand are already matters in evidence in this case?

A. Yes, sir.

Q. And the matter of the average is a new element in the case, or is that also in the exhibit that you have examined?

A. The elements which enter into the average are in the exhibit.

Q. Then this chart is a combination of mathematical determinations and data which are already in evidence, as you understand it?

A. Yes, sir.

Q. And a graphic representation of these mathematical results?

A. Yes, sir.

Q. And that is all this chart is?

A. Yes.

Mr. Riker: The offer is objected to on the same grounds as the last offer was objected to, with the exception, of course, of the objection as to the distance to the point of sampling.

2824½ The Commissioner: Note the objection of counsel for defendants. Received and marked Complainants' Exhibit No. 164.

Marked Complainants' Exhibit No. 164.

Q. Did you from studying these exhibits make any other cross-section of the Hudson River than the one you have testified to?

A. I made another of the Hudson River at Mount St. Vincent.

Complete tests of dissolved oxygen in water, made by Metropolitan Sewerage Commission October 13, 1911, samples being taken at 5 points—500 ft. off Mt. St. Vincent, ¼ way across, ½ way across, ¾ way across, and 500 ft. off West shore—3 depths—1 ft. below surface, 10 to 20 ft. below surface, 15 to 40 ft. below surface.

Tests began at 7.45 A. M. and ended at 5.50 P. M.—6 runs. Runs began at 7.45, 9.45, and 11.45 A. M. and at 2, 4, and 5.15 P. M. In general the regular schedule was followed, of 2 minutes between samples on vertical plane, and 4 minutes between stations.

Temperatures at surface ranged from 15½° to 16° C. = 59.9° to 60.8° F.; below surface from 15° to 16° C. = 59° to 60.8° F.

Per cent. land water and oxygen required to saturate the water varied as follows:

Surface, flood	64% — 72%	6.5 c. c. — 6.6 c. c.
ebb	64% — 80%	6.5 c. c. — 6.7 c. c.
Below surface, flood	60% — 70%	6.5 c. c. — 6.6 c. c.
Below surface, ebb	58% — 74%	6.5 c. c. — 6.6 c. c.

Dissolved Oxygen—Surface:

Minimum, 4.78 c. c. = 73% Ebb & Flood.
Maximum, 5.97 c. c. = 88% Ebb.
Average, = 79%.

Dissolved Oxygen—Below Surface:

Minimum, 4.38 c. c. = 67% Flood.
2825 Maximum, 5.68 c. c. = 85% Ebb.
Average, = 77%.

Average Dissolved Oxygen entire run, all depths, 77.9%.

Dissolved Oxygen—Surface Samples—Average of each run:

7.45 A. M. — 8.21 A. M. 86% Ebb.
9.45 " " — 10.21 " " 88% "
11.45 " " — 12.21 P. M. 76% Flood.
2.00 P. M. — 2.36 " " 75% "
4.00 " " — 4.36 " " 76% Ebb.
5.15 " " — 5.50 " " 78% "

Dissolved Oxygen—Below Surface—Average of each run:

7.45 A. M. — 8.21 A. M. 82% Ebb.
9.45 " " — 10.21 " " 82% "
11.45 " " — 12.21 P. M. 74% Flood.
2.00 P. M. — 2.36 " " 69% "
4.00 " " — 4.36 " " 76% Ebb.
5.15 " " — 5.50 " " 80% "

These tests show that the dissolved oxygen did not rise above 88%, nor fall below 67%. The lowest average of surface samples, on a single run, was 75%, the highest 86%. The lowest average in samples taken below the surface, was 69% while the highest was 82%.

The variation between amount of dissolved oxygen in surface, mid-depth, and bottom samples, ranged from 0 to 6%. The amount of dissolved oxygen in surface samples was generally higher than bottom samples, except in the case of the last two runs of the day. The run from 4 to 4.36 P. M. averages were just the same, and the run from 5.15 to 5.50 showed a per cent. for the bottom samples of 2% higher than the surface samples.

Averages of surface samples taken at each station across the river showed a regular increase in the per cent. of saturation, from
2826 the East to the West sides.

Q. Did you cause this date that you have just testified to to be put in graphic form?

A. I did.

Q. And did you sign the original?

A. I did, and called it Figure No. 7.

Q. And is your signature reproduced on the blue-print copy which you now have?

A. It is.

Q. And do you recognize it as such?

A. I do.

Mr. O'Sullivan: I offer the chart marked Figure No. 7, just testified to by this witness, purporting to show the dissolved oxygen con-

tent at a cross-section of the Hudson River at Mount St. Vincent, I offer it in evidence and ask that it be marked Complainants' Exhibit No. 165.

Cross-examination by Mr. Riker:

Q. How far is this cross-section from the proposed point of discharge of the Passaic Valley Sewer?

A. About 17 miles, I should say.

Q. The solid lines indicated here are apparently drawn to unite certain points, am I right about that?

A. Yes.

Q. They do not indicate any data at all between the points, do they?

A. No.

Q. That is an assumption that the rate of increase is uniform between the points?

A. Yes.

Q. And so far as the lines themselves are concerned, those are merely hypothetical, are they not?

A. Yes; they are subject to some variation. The points are correct; the lines are assumptions.

Q. The chart itself, the original, was prepared in the same way as the others that have been produced here?

A. Yes, sir.

Mr. Riker: The offer is objected to on the same grounds as were urged on the offer of the exhibit next preceding the last one.

The Commissioner: Note the objection of counsel for defendants. Received and marked Complainants' Exhibit No. 165.

Marked Complainants' Exhibit No. 165.

2827 Q. Did you complete any studies from the data in evidence as complainants' exhibits relative to the dissolved oxygen determinations with a view to determining the condition of the waters in the Kill van Kull?

A. Yes, sir.

Complete tests of dissolved oxygen in water made by Metropolitan Sewerage Commission October 4, 1911, samples being taken at 3 points—100 ft. off New Brighton, mid-way across, and 100 ft. off Columbia Oil Company—at 3 depths—1 ft. below surface, 15 to 20 ft. below surface, and 25 to 40 ft. below surface.

Tests began at 7.30 A. M. and continued to 5.52 P. M.—6 runs. Each run began at half after the odd hour, the samples in the different tests at each point being taken about 2 minutes apart, and the time elapsing between the taking of the last sample at one point and the taking of the first sample at the next point was 5 minutes in each case. The time elapsing between runs was 1 hr. 38 minutes.

Temperatures varied from 17° to 18.5° C. = 62.6° to 65.3° F.

Per cent. land water and oxygen required to saturate the water varied as follows:

Surface, flood	26% — 34%	5.9 c. c. —	5.9 c. c.
" ebb	34% — 36%	6.0 c. c. —	6.0 c. c.
Below surface, flood	24% — 32%	5.8 c. c. —	6.0 c. c.
" surface, ebb	32% — 34%	6.0 c. c. —	6.0 c. c.

Dissolved Oxygen—Surface:

Minimum, 4.10 c. c. = 68% Ebb.
Maximum, 4.54 c. c. = 77% Flood.
Average, = 72%.

Dissolved Oxygen—Below Surface:

Minimum, 4.26 c. c. = 72% Flood.
Maximum, 4.78 c. c. = 81% Flood.
Average, = 76%.

2228 Average Dissolved Oxygen, entire run, all depths, 75% (54 samples ebb and flood).

Dissolved Oxygen—Surface Samples—Average of each run:

7.30 A. M. —	7.52 A. M.	71% Flood.
9.30 " " —	9.52 " "	75% Ebb.
11.30 " " —	11.52 " "	69% "
1.30 P. M. —	1.52 P. M.	71% Flood.
3.30 " " —	3.52 " "	71% "
5.30 " " —	5.52 " "	75% "

Dissolved Oxygen—Below Surface—Average of each run:

7.30 A. M. —	7.52 A. M.	77% Flood.
9.30 " " —	9.52 " "	76% Ebb.
11.30 " " —	11.52 " "	74% "
1.30 P. M. —	1.52 P. M.	75% Flood.
3.30 " " —	3.52 " "	74% "
5.30 " " —	5.52 " "	79% "

These tests show that the dissolved oxygen did not rise above 81% and did not fall below 68% on individual tests. The lowest average of surface samples on a single run was 69%, the highest average for any run being 75%.

The lowest average of mid-depth and bottom samples, on a single run, was 74%, while the highest was 79%

The difference between the dissolved oxygen content of the bottom samples and the top samples amounted, in some cases, to as much as 10%—for example in the samples mid-way across, taken between 7.39 and 7.43 A. M. the top sample was 71% and the bottom sample 81% saturation.

There was a slight but uniform increase in the per cent. saturation, going from the Staten Island side to the New Jersey side of Kill van Kull.

The average of all samples, including surface, mid-path, and bottom samples, was 75%.

2229 Q. Did you cause the data just testified to to be put in graphic form?

A. I did.
Q. The blue-print which you just now hand me, does it reproduce your signature?
A. It does. The print is called Figure No. 8.
Q. Whose signature is it?
A. It is mine.
Q. Made on what?
A. On the tracing.
Q. On the original?
A. On the original.
Q. From which this is reproduced?
A. Yes, sir.

Mr. O'Sullivan: I offer the chart or blue-print produced by this witness showing cross-section of the Kill van Kull for the purpose of dissolved oxygen determinations near New Brighton on October 4, 1911, and ask that it be marked Complainants' Exhibit No. 166.

Cross-examination by Mr. Riker:

Q. Is there any more original work on this chart than there was on the last one?
A. The same amount.
Q. Consisting of mathematical determinations of averages and graphic representations of those averages?
A. Yes, sir.
Q. Nothing else?
A. Nothing else.

Mr. Riker: The same objection as to the last offer, with the exception of the objection to the distance of the point of observation to the proposed point of discharge of the Passaic Valley sewer.
The Commissioner: Note the objection of counsel for defendants. Received and marked Complainants' Exhibit No. 166.
Marked Complainants' Exhibit No. 166.

Direct examination by Mr. O'Sullivan (resumed):

Q. From your study of these oxygen determinations, which have been marked as Complainants' exhibits, can you state what you found the condition of the water in Newark Bay at a cross-section to be, and also state where the cross-section was made by you from these determinations?

A. I made such a cross-section at a point just below the
2830 Central Railroad of New Jersey trestle.

Complete test of dissolved oxygen in water made by Metropolitan Sewerage Commission October 6, 1911, samples being taken at 3 points—300 ft. off East Shore, in Channel near draw, ½ way across Bay, ¾ way across, 300 ft. from West Shore. In general samples were taken at 2 depths, 1 ft. below surface and near the bottom, varying from 6 to 10 ft., except in the Channel near the draw, where, owing to greater depth of water, samples were taken at 3

depths—1 ft. below surface, 15 ft. below surface, and 30 ft. below surface.

Tests began at 8 A. M. and were continued at 10.12 2 P. M., 3.30 & 5.—6 runs— The first sample of each run was taken 300 ft. off East Shore (Bayonne). In general the customary schedule was followed, there being an interval of about 2 minutes between the surface, mid-depth and bottom samples at each station, and a 4 minute interval between stations.

Temperatures at the surface varied from 15½° to 16° C. = 59.9° to 60.8° F.

Per cent. land water and oxygen required to saturate the water varied as follows:

Surface, flood..... 38% — 48% = 6.2 c. c. to 6.4 c. c.
ebb ..... 40% — 54% = 6.2 c. c. to 6.4 c. c.
Below Surface, flood..... 32% — 46% = 6.1 c. c. to 6.3 c. c.
Below surface, ebb..... 38% — 54% = 6.2 c. c. to 6.4 c. c.

Dissolved Oxygen—Surface:

Minimum, 3.55 c. c. = 56% Flood.
Maximum, 4.51 c. c. = 71% Ebb.
(4.48) "
Average, = 64%.

2831 Dissolved Oxygen—Below Surface:

Minimum, 3.55 c. c. = 56% Flood.
Maximum, 4.48 c. c. = 71% Ebb.
Average, = 64.6%.

Average Dissolved Oxygen entire run, all depths, 64.3% (66 samples).

Dissolved Oxygen—Surface Samples—Average of each run:

8.00 A. M. — 8.28 A. M. 62% Ebb.
10.00 " " — 10.28 " " 67% "
12.00 Noon — 12.26 P. M. 69% "
2.00 P. M. — 2.26 " " 66% "
3.30 " " — 3.58 " " 61% Flood.
5.00 " " — 5.28 " " 59% "

Dissolved Oxygen—Below Surface—Average of each run:

8.00 A. M. — 8.28 A. M. 63% Ebb.
10.00 " " — 10.28 " " 67% "
12.00 Noon — 12.26 P. M. 70% "
2.00 P. M. — 2.26 " " 66% "
3.30 " " — 3.58 " " 61% Flood.
5.00 " " — 5.28 " " 59% "

These tests of dissolved oxygen show that it did not rise above 71% and did not fall below 56%, on individual tests. The lowest average of surface samples, on a single run, was 59%, the highest 69%. The

lowest average of mid-depth and bottom samples was 59%, the highest 70%.

The difference between the dissolved oxygen content in the surface, mid-depth and bottom samples, was very slight, ranging on the average of each run, from 0 to 1%, although in individual tests there was a difference of 5%. The averages of surface samples at each station, vary only slightly.

Q. Did you cause to be graphically reproduced the facts that you have just testified to relative to the cross-section of Newark Bay?

A. I did.

2832 Q. Was it prepared in the same way as the other figures that you have offered today?

A. Yes, sir, and is called Figure No. 9.

Mr. O'Sullivan: I offer the chart of the cross-section testified to by this witness, showing in graphic form the dissolved oxygen content at the point described by this witness, I offer it in evidence and ask that it be marked Complainants' Exhibit No. 167.

The Commissioner: Received and marked Complainants' Exhibit No. 167.

Marked Complainants' Exhibit No. 167.

Q. Mr. Weston, what relation has oxygen to the purification, so called, of sewage discharges. State what you mean by the purification of sewage?

A. By the purification of sewage is meant the transformation of unstable organic matter, through the growth of bacteria, into stable compounds, ultimately into mineralized nitrogen (nitrates), carbon dioxide and water,—This is a burning process and requires oxygen. The nitrogenous matter burns to nitrates and the carbonaceous to carbon-dioxide. It is true that partial purification or more correctly digestion can take place by fermentation in the absence of oxygen, but such a process is noisome and objectionable.

Dissolved oxygen, therefore, is the reagent which effects non-putrefaction and bacterial purification, and like any other reagent, especially one not uniformly diffused or acting upon something like sewage, also not uniformly diffused, must be present in excess.

I have made analyses and frequent careful observations of the waters of Boston Harbor and have noticed offensive conditions where the water was 70% saturated with oxygen and have never observed inoffensive conditions where the dissolved oxygen was below 40%.

Relative Quantities of Dissolved Oxygen at Various Points in New York Harbor.—A Comprehensive examination into the character of the water in the various arms of the Upper Bay, and in the Bay itself, was made by the Metropolitan Sewerage Commission during the months of September and October, 1911, and I have

2833 just presented a graphic representation of this data. The quantity of dissolved oxygen was determined in the water at several points across the Hudson and East Rivers, the Kill van Kull, the Narrows, and in the Upper Bay, and the results seem to represent with accuracy the character of the water present in these different localities when the samples were taken.

The results of these determinations are as follows:

	Date.	Range in oxygen. c. c.		Average per cent. saturation.
		Min.	*Max.*	
Hudson River at Mt. St. Vincent..	Oct. 13..	4.38	5.97	77.9
" " at Pier A.....	Sept. 28..	2.73	3.62	55.0
East River at Pier 10, Brooklyn....	" 29..	2.73	3.36	54.0
Upper Bay	Oct. 16..	4.10	4.78	75.0
Kill van Kull.....	" 4..	4.10	4.78	75.0
Narrows	Sept. 26..	3.69	5.04	78.6

The cross-sectional determinations of dissolved oxygen upon which these averages have been based, are shown upon the diagrams, and may be studied in detail from them and from the tables of ranges and averages. It should be borne in mind that these determinations were made in the fall of the year when the temperatures of air and water were slightly lower than would be the case during July and August, so that the results given are probably higher than would have been the case had the cross-sections been made during the hot weather of the summer. In regard to the above point, it may be said that an absence of satisfactory cross-sections taken during the summer as well as variable conditions such as currents, amount of land water, etc., makes it impossible to determine the effect of changing temperature by a direct comparison of analyses made in the summer with those made in the autumn.

2833½

An examination of the temperature of the water near Robbins Reef, in 1911, however, shows a range from about 24° C in summer to 15° C in late October, at this latter and lower temperature the water will dissolve about 15% more oxygen than at the higher summer temperature. Furthermore, increased bacterial life in the hot weather causes a greater depletion of the oxygen in the summer than in the autumn.

The effect of pressure on the dissolved gases is also marked. For example, if sewage loaded with odoriferous gases were discharged into water from a sewer under pressure, the release of the pressure at the point of discharge would tend to release the gases dissolved in the sewage. This is especially true if septic sewage be pumped from a tank through a long pressure tunnel without opportunity for the escape of gases between the pump and the point of discharge.

At 1 P. M., adjourned for noon recess until 2 P. M.

2834 CORPORATION COUNSEL'S OFFICE,
September 3, 1912, 2 p. m.

ROBERT SPURR WESTON, a witness called on behalf of Complainants, recalled for further examination, testified as follows:

Direct examination by Mr. O'Sullivan (resumed):

Q. Now, Mr. Weston, have you prepared any diagram or diagrams which would show the various determinations for dissolved oxygen made by the Metropolitan Sewerage Commission in 1911, and which are already in evidence in this case as exhibits?

A. I have prepared diagrams which accompany the explanatory notes on the various dissolved oxygen determinations made by the Metropolitan Sewerage Commission in 1911, and introduced this morning. Figure 10 has an epitome of these notes and diagrams. The diagrams which I have prepared accompany the explanatory notes on the various dissolved oxygen determination made by the Metropolitan Sewerage Commission in 1911.

Figure 10 has been prepared to show the average quantities of oxygen dissolved in the water at various points. This diagram shows that the average percentages of saturation found at the time of these tests at the Battery were 55% at the mouth of the Hudson and 54% in the East River, respectively. In my opinion the reduction of oxygen at this time approached the safe limit, which limit I place at about 50% of saturation, although during the warmer months and with higher percentages of sea-water,—dissolving less oxygen,—50% of saturation might be insufficient.

No cross section of the Upper Bay, in order to determine the amount of dissolved oxygen present, was made in the vicinity of Robbins Reef. Numerous tests, however, were made on October 16 and 23, and on November 4, 1911.—those of October 16 being shown in Figure 10. These tests indicate the dissolved oxygen is approaching a safe limit of depletion, the minimum quantity being found equivalent to 65% of saturation. These results were
2835 obtained on October 16, 1911, and apply to both the surface and deep samples. The temperature of the water at this time was about 16° Faht. and about 30% of the water was land water.

It is important to note that at Mt. Vincent as indicated by Figure 10 sufficient sewage had been diffused through the waters of the river to cause, directly or indirectly, a reduction of the dissolved oxygen saturation value to 87%, and that it had been reduced when the mouth of the river was reached, to 55% saturation, Fig. 10. It is important also to note that the character of the water in East River near its mouth was substantially the same as that of the Hudson River at its mouth.

From the Battery southward there appears to be a gradual increase in the quantity of dissolved oxygen as the Narrows are approached, at which point the average saturation was found to be 78.6%. The character of the water at or near Robbins Reef was distinctly inferior to that at the Narrows, but it was somewhat bet-

ter than that at the Battery, showing the effect of the dilution with fresh sea water coming in through the Narrows at times of flood tide. The dissolved oxygen tests made on July 12,-13, when a course was run from Yonkers to the open sea Buoy 6 in Ambrose Channel, show relatively little difference between the character of water at Robbins Reef and that at the Battery, and indicate that the water at Robbins Reef has only slightly more capacity for receiving and assimilating sewage than that at the Battery. These results plotted on Fig. 11. It is, therefore, proposed to discharge the sewage from 1,649,000 persons at a point in New York Harbor where the dissolved oxygen in the water is nearly as low as at any point in the main arteries, and where contamination is plainly evident, even at present, although it has not reached an objectionable limit.

Q. Have you got those charts that you describe as figures 10 and 11 with you?

A. I have figure 10, showing the dissolved oxygen average of cross sections taken in the Autumn of 1911, and figure 11 showing dissolved oxygen in the Hudson River and New York Bay from Yonkers to Buoy 6 Ambrose Channel, July 12,-13, 1911.

Mr. O'Sullivan: I offer figure 10, described by this witness, purporting to show the dissolved oxygen average of cross
2835½ section taken in the Autumn of 1911. I offer it in evidence and ask that it be marked Complainants' exhibit No. 168.

Cross-examination by Mr. Riker:

Q. Mr. Weston, this is an assemblage on one chart of the matters shown on the other charts that you produced here?

A. It is a condensation of figures 1 to 9 inclusive.

Q. A condensation?

A. Well, an abstract, if you call it that.

Q. It has no new matter in it?

A. No, it is simply another way of putting the data.

Q. Putting it all together on one chart, is it not?

A. That is all.

Mr. Riker: The same objection to this chart as to the others.

The Commissioner: Note the objection of counsel for the defendants. Received and marked Complainants' exhibit No. 168.

Marked Complainants' exhibit No. 168.

Direct examination by Mr. O'Sullivan (resumed):

Q. Was Figure 11 prepared under your direction in the same way as the other figures that have already been put in evidence through you?

A. Yes, sir.

Mr. O'Sullivan: I offer Figure 11, which is produced by this witness, purporting to show the dissolved oxygen in the Hudson River, and New York Bay from Yonkers to Buoy 6, Ambrose Channel,

July 12, 13,-1911. I offer this chart in evidence and ask that it be marked Complainants' exhibit No. 138.

Cross-examination by Mr. Riker:

Q. How does this differ from Figure 10, Mr. Weston?

A. Figure 11 was prepared in the same general manner as figures 1 to 9 inclusive. It is based on data by the Metropolitan Sewerage Commission. Figure 10 is a re-statement of the data in figures 1 to 9 inclusive, and does not include data given in Figure 11.

Q. The data in figure 11 then is entirely distinct from the data in figure 10?

2836 A. It is a separate experiment, yes.

Q. And are any of the elements that are noted here in this graphic illustration included in figure 10?

A. No.

Q. What does the broken solid line indicate?

A. The solid line indicates the surface samples, and the broken line the deep samples.

Q. And at each end of the solid line it indicates 100% saturation, does it?

A. Yes.

Q. Is that the result of samples, 100% saturation?

A. Yes.

Q. And the upper end at Fort Washington, there you find complete saturation?

A. Yes.

Q. And the dotted line below the solid line, what does that mean?

A. That indicates the average of deep samples.

Q. Does that indicate on this diagram at any points complete saturation?

A. None except below Craven Shoal Buoy, where the surface and deep samples are alike? They merge one into the other.

Q. They are the same at that point, but at the other end the deep samples do not come anywhere near saturation?

A. No. Well, they come within 80 per cent of it to be exact.

Q. Did you have the figures before you, the data before you, to determine the surface conditions at Riverdale?

A. No.

Q. But you did have the deep samples at that point?

A. Yes, I did.

Q. There were not any?

A. No, those all there were on that experiment. Every test included in those days' work is plotted on that chart.

Q. That is only one day's work?

A. One day's work—two days' work, beg pardon, July 12 and 13.

Q. This chart contains only the same amount of work by you as the other charts?

A. Exactly.

Mr. Riker: It is objected to for the same reasons.

The Commissioner: Note the objection of Counsel for the Defendants. Received and marked Complainant's exhibit 169.
2837 Marked Complainants' exhibit No. 169.

Direct examination by Mr. O'Sullivan (resumed):

Q. Mr. Weston, what relation has temperature to bacterial purification of sewage?

A. It is true that as the temperature increases, the rate of bacterial purification increases correspondingly and at such times the water contains less of the needed oxygen and also dissolves less of the odoriferous sewage gases evolved.

Q. Have you made any observations in Boston Harbor relative to sewage disposal?

A. Yes, *sir*.

Q. Will you state what observations you made?

A. I have made many observations of Boston Harbor and of the sewer outfalls at Moon Island, Deer Island and Nut Island, respectively, and have made several determinations of the dissolved oxygen in the harbor water itself.

On July 28th, 1911, I made a special study of the conditions about the outlets in Boston Harbor.

At Moon Island where the sewage is stored in tanks and discharged on the ebb tide, the conditions are exceedingly offensive and I know from my own observation that property on the once fashionable peninsular of Squantum, one mile away, has depreciated, because of this discharge at Moon Island. On an average 39 Mg of sewage are discharged at the surface daily.

At Deer Island North Metropolitan Sewer, the sewage is pumped into the tideway near Deer Island Light. An average of about 82 Mg of sewage are discharged at a depth of less than 10 ft., daily. Because of the position of this outlet, corresponding as it does to Coney Island in New York Bay, the dilution is enormous and the shores of the neighboring islands and main land are not affected. The discharge is very evident, however, to passengers on passing vessels and a sleek is apparent except under conditions of very high wind.

It must be borne in mind when making this comparison that the rise and fall of the tide and consequently the tidal flow in
2838 Massachusetts Bay is more than twice that in New York Bay and consequently the dilution of sewage is greater, other conditions being equal. In my opinion, the discharge of 206 million gallons of sewage at Deer Island, Boston, daily, would be objectionable, especially if allowed to become septic in subsiding basins before discharging.

I have determined the specific gravity of sewage from the North Metropolitan Sewer, discharging at Deer Island, also the specific gravity of sea water from Revere Beach, four miles away. The specific gravities are approximately 1.0018 and 1.025, respectively. The later figure is a fair average for coastal sea water. The sample of sewage contained over 1,022 parts of chlorine per million, and,

consequently the specific gravity was higher than Passaic Valley sewage is likely to be, and therefore, the Passaic Valley Sewage is more liable to rise to the surface than that from the Deer Island outlet.

At Nut Island, about 40,000,000 gallons of sewage are discharged at a depth of 69 ft. daily. This sewage is much fresher than that discharged at Deer Island and although the smaller amount discharged at a greater depth is unobjectionable, the sewage rises to and spreads over the surface of the harbor and may be detected at times by its odor.

Q. Have you made any observations in Lynn Harbor?

A I have. I might add that I have supplemented these observations in Boston Harbor made last year with frequent trips over the Deer Island outlet. There are several lines of steamers running out of Boston Harbor to nearby resorts, and I have made it a point to spend some of my half holidays in passing to and fro over this outlet. I have noticed in every case, eight in all, I think—seven in all—in every case but one there was an odor apparent to passers by in steamers from the sewage discharged near Deer Island Light.

On August 27th, 1912, I went to Lynn and made a series of examinations of the harbor water in the vicinity of the Broad Street Sewer, one of the smaller sewers, and the main sewer outfall, respectively. The Broad Street Sewer, which discharges the
2839 largest part of the sewage of the City is supposed to be a surface water drain and discharges storm water, and also some sewage which enters it surreptitiously, I might say, a great deal. The main sewer discharges somewhat stale sewage into the harbor at a point 200 feet from the shore, and just below the low tide mark. The quantity of sewage being discharged from the outfall sewer is estimated to be 8,000,000 gallons per diem on an average. The discharge takes place in the harbor above the point where the Saugus River enters, and, except when driven outward by the wind, the tidal prism oscillates day after day without completely displacing the water, making it an excellent place to study the relations between offensive conditions and the percentage of dissolved oxygen.

On August 27th, 1912, there was a strong northwest wind with high tide at about 11:15 A. M. The conditions were most favorable for a rapid disposal of the sewage by dilution, as the wind drove the dead water out of the shallow harbor and helped to mix it with the unpolluted water farther out.

I might add that the general direction of the long narrow harbor is from northwest to southeast.

Observations were made between high and low tide in order to obtain average conditions for the day. The average results of these observations are given in the following table.

Cross-examination by Mr. Riker:

Q. Did you determine the temperature?

A. Yes sir.

Q. Yourself?
A. Yes sir.
Q. And the oxygen percentages, did you determine that?
A. No sir.
Q. Who did?
A. My assistant.
Q. Did you take the samples?
A. I helped take the samples and oversaw the determinations of the oxygen.
Q. What is the name of your assistant?
A. His name is Gamage.
2840 Q. Where is he?
A. He is in Boston.
Q. He is so that he can be produced?
A. If necessary yes, sir.
Q. Who determined the amount of land water?
A. I did.
Q. Who took the samples?
A. Mr. Gamage and I together.
Q. Did you take memoranda of the conditions under which you took the samples when you took them?
A. Yes, sir.
Q. Where are those memoranda?
A. In my note book.
Q. Where is your note book?
A. I think it is in my pocket.
Q. Who observed the appearance of the samples?
A. I did.
Q. And you made notations of these in note books?
A. Yes sir.
Q. That you now have in your hand?
A. Yes.

Mr. Riker: I object to the testimony of this witness upon this table, upon the ground that the basis of it has not been properly proved.

The Commissioner: Note the objection of Counsel for the Defendants.

Direct examination by Mr. O'Sullivan (resumed):

Q. Were you with your assistant at the time of the oxygen determinations?
A. Yes sir, he worked under my direction entirely.

Mr. Riker: I make the further objection that it is irrelevant and immaterial to the subject matter of this injury, the conditions in Lynn Harbor at the time the witness is about to testify.

The Commissioner: Note the objection of counsel for the Defendants.

Q. Proceed, Mr. Weston?
A. —.

2841

Location.	Temperature Fahrenheit.	Appearance.	% of land water.	Oxygen percentage saturation.
Near mouth of Broad St. Sewer..	61°	Offensive	7.0	72.
100 ft. South of above.....	65°	slightly "	2.3	86.
1,500 " East of sewer outfall....	66°	Good.....	3.3	90.
700 ft. " " " "	66°	slightly Off...	5.6	72.
350 " " " " "	68°	Offensive.....	11.2	55.
100 " southeast " "	67°	offensive.....	9.4	52.5

This table refers to August 27th, 1912.

Q. Mr. Weston, did you make any observations relative to the sleek?

A. The sleek on the surface of the harbor extended in a southeasterly direction from the mouth of the sewer for a distance of over one mile and for a breadth of one quarter of a mile at the widest point. The water was markedly turbid for a distance of at least one half mile from the sewer outlet and large masses of green seaweed, detached from the bottom by the waves, were floating in the water. These caused a very disagreeable odor. These growths are similar to those observed at Belfast, Ireland, where there existed an intolerable condition, due to the discharge of sewage into the estuary.

It will — noted in the above table that the harbor water in the vicinity of the Broad Street Sewer was offensive when the water was 72% saturated with oxygen.

It is fair to say, I think, that a part of this offensiveness was due to the gases brought in with the sewage.

Q. What is the permissible limit for dissolved oxygen, so as to obviate these objectionable conditions?

A. As a result of experience and observation, it is my opinion that where sewage is discharged into a tidal harbor containing a mixture of fresh and salt water, the mixture of water and sewage should contain from 50-70% of the oxygen necessary to saturate the water at any given temperature in order to dispose of the sewage by dilution in a satisfactory manner, and without offense.

2842 And where a limited opportunity is afforded for the replacement of the water in the harbor, the mixture of water and sewage should contain from 50-70% of the oxygen necessary to saturate the water at any given temperature in order to dispose of sewage by dilution in a satisfactory manner, and without offense.

There is another important consideration where fresh sewage is discharged into a harbor in which the tidal prism oscillates for many days without complete daily displacement of the water, and that is, the odor discharged in the harbor with the sewage and spread over the surface thereof with the sleek. I have seen cases where this odor could be observed a mile away from the point of discharge and I believe that under such conditions not only is a thorough mixing of the sewage with the harbor water essential, but the mixture should be more highly saturated with oxygen than where the sleek is not visible,—perhaps as high as 70% of saturation. This degree of saturation should be maintained in the immediate vicinity of Robbins Reef.

I have paid especial attention to the appearance of the East River during the past year and have noticed especially the condition of the water in the vicinity of Brooklyn Bridge where the results obtained from the Metropolitan Sewage Commission show that on the average it is 54% saturated with oxygen. These results were taken in the Fall, and do not represent hot weather conditions. They do represent average conditions. The condition of this river represents to me the permissible limit of pollution. I believe that any material increase in the amount of sewage would result in extremely offensive conditions.

I might qualify this statement by saying that I believe the present condition of the East River is on the good side of the permissible limit rather than on the bad side. Therefore, I believe that the water of the Upper Bay would be maintained in such a condition (as far as the degree of saturation with oxygen is concerned) that the amount of oxygen should never fall below 50% of saturation.

Q. What will the general effect of the discharge of sewage
2843 at Robbins Reef be?

A. The general effect of the discharge of sewage at Robbins Reef will be to cause a large increase in the quantity of dissolved putrescible matter in the waters of the Harbor and a reduction in the quantity of oxygen dissolved in these waters. The immediate effect will be the introduction of large volumes of offensive gases with the inflowing sewage. If the quantity of dissolved oxygen in the waters of the Upper Bay be reduced, it follows that the waters entering the Hudson and East Rivers, the slips, bays, creeks and other arms of the Bay, will have a lessened capacity for assimilating the impurities which are now discharged into them. Where, as in the East River, conditions are at the present time fairly satisfactory, because the quantity of oxygen is adequate for the assimilation of the sewage, the conditions may be very different if the water entering the Bay and its tributaries is depleted to a greater extent of its supply of dissolved oxygen, as will be the case if the Passaic Valley project be carried to completion.

The dissolved oxygen tests show very clearly that the waters of the harbor at all points covered by the tests now receive sufficient sewage to cause a material reduction in the amount of dissolved oxygen and at several points,—as at the mouth of the Hudson, the East River at the Battery, and the upper Bay at Robbins Reef,—the oxygen is reduced to nearly the permissible limit. A further increase in the quantity of sewage discharged into these waters would cause a further decrease in the amount of dissolved oxygen, and it would follow that a discharge of more sewage at Robbins Reef would cause a further decrease of oxygen in the waters of the Upper Bay.

Q. Have you studied the stipulation entered into between the federal government and the State of New Jersey relative to the purifying processes to be applied to the sewage proposed to be discharged from the outfall of the Passaic Valley Trunk Sewer?

A. I have.

Q. With what results?

A. Under the second part of the agreement between the United

States Government and the State of New Jersey and the
2844 Passaic Valley Sewerage Commission, are found certain specifications of results which the Passaic Valley Sewerage Commissioners have agreed to produce. These may be considered briefly as follows:

1. There will be absence in the New York Bay of visible suspended particles coming from the Passaic Valley sewage.

The sizes of screens and the rate of flow through sedimentation basins proposed by the Passaic Valley Sewerage Commission will not prevent visible suspended particles from being discharged into New York Bay. Furthermore, the amount of suspended matter will be great enough to impart an unattractive appearance to the waters of the Upper Bay, especially in the vicinity of the discharge area.

2. There will be absence of deposits objectionable to the Secretary of War of the United States in New York Bay coming from the Passaic Valley Sewage.

There will be deposits of sewage sludge in the waters of the Upper Bay. The passage of sewage through a trunk sewer tends to change certain suspended matters into colloidal suspended matters. These will be precipitated from the sewage by the salt water of the Bay. I am unable to say whether or not these would be objectionable to the Secretary of War.

3. There will be absence in the New York Bay and its vicinity of odors due to the putrefaction of organic matters contained in the Passaic Valley sewage thus discharged.

The sewage would be putrid at times and pent up odors from the pressure tunnel would be set free near Robbins Reef. The provision for the dispersion of the sewage in the waters of the Bay would not prevent this effect,—namely, the production of a sinking area in the main channel of the Upper Bay.

4. There will be a practical absence on the surface of New York Bay of any grease or color due to the discharge of the Passaic Valley Sewage at the dispersion area or elsewhere.

A film of grease, the so-called sleek, would indicate the area
2845 of discharge even if this condition be construed as a "practical absence" of grease. Besides the sleek, visible and unsightly patches of grease would appear on the surface of the water. These could be recognized at long distances from the area of discharge.

At times the large amounts of industrial waste, including spent dye liquor, and the dark septic sewage itself would impart a color to the surface of the Bay visible even for a long distance from the area of discharge.

5. There will be no injury to the public health which will be occasioned by the discharge from the said sewer into the Bay of New York in the manner proposed and no public or private nuisance will be created thereby.

A discussion of the probable effect of the carrying out of the Passaic Valley project upon the health, convenience and happiness of those who either live on the shores of New York Bay and its tribu-

taries, or who travel its waters for business and pleasures needs further elaboration.

Q. Assume that the facts and data have been proven as set forth in Complainants' Exhibits from Numbers 1 to 158 inclusive; assume that these exhibits from numbers 1 to 158 inclusive set forth correctly the observations, statistics, chemical analyses, bacterial determinations; photographic reproductions of places and things observed; charts and maps of contours of surface and sub-surface localities; apparatus employed, together with the reports made thereon by the observers, and now in evidence in this case, have been proven. Assume, also, that the tabulations of oxygen determinations, the tabulations of Bacterial count; the tables for averages for oxygen determinations, bacterial count and harbor deposits; the charts plotting float observations, oxygen percentages, bacterial count, and mud-examinations; the current observations, report of tidal actions, and graphic charts thereof; current velocities, indices of sample stations and plottings thereof; microscopic examinations of harbor
2846 deposits, photographs and charts of sewage fields, dispersion areas, and sleek fields; all as set forth in Complainants' Exhibits from numbers 1 to 158, inclusive, and such other scientific data as are included in these exhibits, are proven.

Assume, also that the testimony which you have reviewed and which has been given by witnesses preceding you in the hearings in the present suit between the State of New York and the State of New Jersey, on all these enumerated matters, and also on the precipitation; run-off; present and prospective populations of the drainage areas, and such other scientific data as has been included in the testimony given thereon, have proven the matters therein testified to—

Taking all these facts and circumstances of record in this case, and facts observed by you, and to which you have testified into your full consideration, what, in your opinion, will be the results of the contemplated discharge from the Passaic Valley Trunk Sewer outlet into New York Upper Bay, in the vicinity of Robbins Reef, on the Harbor Waters and tidal waters of New York Harbor, under present existing conditions and under prospective conditions, on or about the year 1940, and during the intervening period between the present year, 1912, ans the year 1940?

Mr. Riker: The question is objected to on the ground that it does not comply with the law with reference to hypothetical questions, in that it does not present to the witness the specific facts upon which his testimony is to be based, so that it may be determined whether or not the facts assumed by him as the basis for his reply have been proved, and are facts determined as shown by the evidence in the case.

The Commissioner: Note the objection of Counsel for Defendants.

A. The primary effect of the discharge——

Mr. Riker: Excuse me one moment. The further Objection that it does not appear that this witness has any knowledge by evidence

of facts produced in this case to determine what the proposed discharge of the Passaic Valley Sewer is to be, nor has he testified to what he understands such discharge to be.

2847 The Commissioner: Note the further objection of counsel for the Defendants.

A. The primary effect of the discharge of sewage, assuming the data mentioned in your question, and also assuming that the discharge of sewage would be substantially as outlined in the 1st published report of the Passaic Valley Sewerage Commission, would be the creation of a stinking area in the vicinity of the Robbins Reef Light House. There are, however, important other effects.

The character of the sewage proposed to be discharged by the Passaic Valley project has been discussed before and it is my opinion that not only would it be offensive and disagreeable in appearance but would contain germs, which, if allowed access to human beings or their food, or if carried to shell-fish beds by the tide or wind, would cause such deseases as typhoid fever and other intestinal disturbances. What is true of oysters, clams and other shell-fish would be also true of other food to which the water might have access.

The deficiency of dissolved oxygen has already caused some reduction in the major fish life of the harbor and further depletion by the introduction of a large volume of septic sewage would effect a still further reduction, probably driving away certain species now inhabiting the waters of the Bay.

Effect on painted wood and metal: If the dissolved oxygen were compeltely exhausted as would be the case in the sewage itself, hydrogen sulphide would be evolved, which would cause certain paints used to coat wood and iron work to darken in color. This effect has been observed in other rivers and harbors where the dissolved oxygen has been exhausted, notably in the lower Passaic, the Blackstone in Massachusetts and the inner harbor of Baltimore, before the installation of the present sewerage system.

Effect of dilution: The impossibility of obtaining a homogeneous mixture of sewage and the harbor water has been discussed at length. While the volume of water might be adequate, un-

2848 der certain conditions of flow and discharge, to dispose of the sewage by dilution in a satisfactory manner, the tendency of the warmer and lighter sewage to rise to the surface of the colder and heavier harbor water, thereby forming a sewage field, would militate against the results which the Passaic Valley Sewerage Commission claim would be secured. Even if discharged through a large number of outlets, the sewage would show a tendency to rise to the surface in ribbons, which would tend to coalesce at the surface without marked admixture with the harbor water at the area of discharge. The sewage field would then spread over part of the bay and there would be a gradual purification effected by dilution and oxidation, as it was moved to and fro by the tide and wind. The turbidity would first disappear, then the color, and finally the grease film.

The disappearance of the turbidity would be accompanied by the

deposition of a large amount of sludge on the bottom of the harbor, especially in the shoal water northwest of Robbins Reef, for salt or brackish water precipitates the suspended matter from sewage quite readily. Much more quickly than fresh.

Q. What effects would you anticipate would follow the odor and sludge deposits on persons and property?

A. If the sewage does give off odors and form deposits, it will inflict injury on persons and property within the State of New York.

As shown by numerous float observations as well as by a study of the appearance of the Bay, sewage discharged at Robbins Reef will not remain in that vicinity any material length of time, but it will be carried by the tidal and other currents north, at times well into the Hudson River and northeasterly at times well into the East River. With a reversal of the tide this sewage will be carried down the bay and through the Narrows into the Lower Bay, where it will remain and accumulate until a reversal of the tide, when it will be carried back into the Upper Bay. It has been pointed out
2849 that such sewage fields as may form will also be driven by the wind to the shores of the Borough of Brooklyn and the Borough of Richmond. Such fields and the general increase in the quantity of sewage in the waters of the bay will cause the accumulation of grease and filth about the wharves and docks and upon the shores of the city. While some of the coarser of the suspended matter will be removed from the sewage during its passage through the settling basins, there will be large areas in the Upper Bay and elsewhere where the velocity of flow will be much less than in the tanks and at such times and in such places it is reasonable to expect a deposit of such matters upon the bottom of the harbor.

Furthermore, there will be a field of sleek and at times grease scum, and the surface waters will contain relatively large portions of sewage, which would tend to be blown or be carried by the tide to the shores of Brooklyn, including Coney Island, and perhaps as far as Rockaway beaches. Under such conditions, bathing which is not attended with little danger and which is a pleasant and healthful recreation for large classes of people, would be rendered more dangerous and perhaps more unpleasant.

Effect due to the tidal conditions: The studies made by the Metropolitan Sewerage Commission show that at the present time the supply of dissolved oxygen in the waters about New York is materially depleted and the water at certain points in the main arteries is now receiving such large quantities of sewage that the dissolved oxygen is reduced below the safe, permissible limit.

The holding of a large volume of sewage in the waters of the Upper Bay and its tributaries for one or more days would over-tax the capacity of the waters to dispose of the sewage by dilution in a satisfactory manner, even though the arrangements for the discharge of the sewage over an unusually large area be carried to the practical limit.

The general effect would be to transfer the disposal of the sewage and all the disagreeable accompaniments thereof from the
2850 waers of the lower Passaic River and Newark Bay to those of New York Bay and its tributaries. Furthermore, the

volume of sewage now entering the Bay in a purified condition through the Kill van Kull, will be increased by that which now passes around Staten Island through the Arthur Kill. Not only must the Bay dispose of more sewage than at present, but sewage in a semi-putrified and offensive condition. The result would be that the waters of the Upper Bay would be changed for the worse and to a highly objectionable degree.

Effect on commerce: If the Passaic Valley project be carried out, the sewage field would extend across the main channel of the harbor. Incoming and outgoing vessels would pass through this field, except when affected by very unusual wind and tidal conditions. The turbidity, grease and other matter would make the waters of the Upper Bay unpleasant for commerce and tend to make excursions on the harbor unpopular, thereby creating noticeably disagreeable conditions in the largest port of the Country, consequently lessening its prestige and depreciating the value of the Bay for recreation purposes.

If the polluted harbor water were used for washing decks, and in the pantrys and galleys of ships, it would be liable to come into contact with food used by human beings and thereby become a possible source of infection.

Future effect: It may be expected that the volume of sewage will increase in the future, thereby magnifying the ill effects which will be caused during the first few years of operation. Furthermore, if the deposits on the bottom of the harbor accumulate, they will become increasingly objectionable. During the period of storm flow even at the beginning of operation, the volume of sewage discharged would approach the maximum attained after a term of years.

Mr. Riker: I object to this line of testimony as irrelevant and immaterial. It has nothing to do with this inquiry, as to what the effect on the Passaic River will be.

2851 The Commissioner: Note the objection of Counsel for the Defendants.

Q. Proceed, Mr. Weston.

A. The effect on the Passaic River if all of the sewage which now discharges therein be intercepted, would be to change it to a condition which now exists above the Great Falls at Paterson. The method of disposal, however, is not necessary for the relief of the Passaic River, because the same effect could be secured by discharge at another point or better by a proper system of sewage disposal located on the Newark Bay near the mouth of the Passaic River. The effect will be to transfer to New York Bay the same kind of conditions, perhaps not to the same degree as now exist near the mouth of the Passaic.

Cross-examination by Mr. Riker:

Q. Your professional experience, Mr. Weston, has been more largely with water supply than it has been with sewage disposal, has it not?

A. Water supplies, and stream pollution, and to some extent with

sewage disposal. I should say, all in all, about one quarter sewage disposal and three quarters water supply and stream purification.

Q. And have you constructed any sewage disposal plants?

A. Yes.

Q. Where?

A. Well, I have one at Lake Kushaqua; one at Raybrook New York; one at Intervale New Hampshire; I have one at Woodstock New Hampshire; one at West Croton, Massachusetts; one at Woburn, Massachusetts; one at Nantucket, Massachusetts; one building at East Bridgewater; one at East Walpole, Massachusetts.

Q. Will you give me the largest town or city that you have provided sewage disposal work for?

A. Of my own design?

Q. Yes.

A. I have done more work on the preliminary experiments for sewage disposal than I have in the actual construction of it; more on the method than on the means.

Q. Give me the largest one that you have actually put into operation?

A. The largest sewage disposal plant that I have put into operation?

Q. Yes.

A. I think the largest one is at East Walpole, Massachusetts,
2852 about 4,000,000 gallons a day.

Q. And the population of East Walpole is what?

A. I do not know what it is.

Q. In passing your vacations or half holidays, in crossing certain sleek fields in Boston Harbor, did you choose that as a recreation pursuit or did you do that for the purpose of testifying in this suit?

A. I did it for the purpose of informing myself as to what constituted objectionable conditions.

Q. You did not engage in these excursions then primarily for recreation?

A. No, sir.

Q. Had you been retained by the State of New York, or by its counsel in this matter at the time when you made these excursions?

A. I had.

Q. And your attention was then directed to detecting an odor from the sewage there, was it not?

A. I do not know that anybody directed my attention to it.

Q. I did not ask you whether anybody did. I asked you whether your attention was directed to the odor from the sewage discharged there?

A. It always had been directed to it.

Q. You were looking to find it?

A. I was looking to see what was there.

Q. You were endeavoring to discover it?

A. No, I was endeavoring to discover the fact.

Q. You were endeavoring to discover whether there was an odor there?

A. Or not.

Q. Or not?
A. Yes.
Q. Now, returning to your sewage disposal work of 4,000,000 gallons, where does the effluent discharge?
A: Into the Neponset River.
Q. A fresh water stream?
A. Yes, flowing into a tidal estuary.
Q. All rivers finally flow into tidal estuaries, do they not?
A. Sometimes.
Q. Directly or indirectly?
A. Directly or indirectly, yes.
Q. There is nothing peculiar in that respect in the Neponset, is there?
2853 A. Yes, I think there is a distinction between a discharge of sewage into a stream along its upper reaches, the water at last reaching the harbor, and one that discharges into a stream near the estuary.
Q. What is the condition of the water into which you discharge the effluent from these works, fresh or salt or brackish?
A. Fresh.
Q. What is the width of the Neponset at the point of discharge of the effluent?
A. Possibly 40 feet; 40 or 50 feet.
Q. Does the Neponset flow from that point to the mouth through settled country?
A. Yes.
Q. What is the character in a general way of the country?
A. It flows through the City of Norwood, and the City of Boston.
Q. Is this plant in operation?
A. Yes.
Q. Is there an absence in the effluent of visible suspended particles coming from the sewage?
A. Not entirely.
Q. Is there an absence of measurable deposits from the sewage in the bottom of the river?
A. Yes.
Q. Is there an absence of odor due to the putrefaction of organic matter contained in the effluent?
A. From our plant, yes.
Q. And is there a practical absence of grease or color due to the discharge of this effluent into the waters of the Neponset?
A. An entire absence of grease.
Q. And color?
A. There is a slight color, but less than the water into which it discharges.
Q. It is free from *prescible* matter?
A. The effluent?
Q. Yes?
A. Entirely.
Q. What system of putrifaction have you employed on that?
A. Settling tanks, and trickling filters.

Q. In what respect does the effluent produced there differ from the effluent which is stipulated to be produced by the State of New Jersey and the Passaic Valley Sewerage Commissioners in their stipulation as to which you have just testified?

A. It differs in the main in that it is nonputrescible and free from grease.

2854 Q. Well, entirely free from grease?

A. Entirely; yes sir.

Q. You remember that the stipulation requires that there will be practical absence on the surface of New York Bay of any grease?

A. Practical absence; yes.

Q. And yours differs in the respect that there is an entire absence; is that the difference?

A. An entire absence, yes.

Q. Will you explain what that difference consists in, between practical absence, and entire absence to your mind?

A. Practical absence conveys very little to my mind just as words. I think that would have to be agreed upon.

Q. Well, then, when you say there is a difference between your effluent and that prescribed by the stipulation, just what do you mean?

A. The difference between nothing and some. The effluent from this plant has absolutely no grease. From the Passaic Valley Plant I understand it is not claimed that it will be free from grease.

Q. Where do you get your ideas of what is claimed with reference to this discharge; where do you get it from?

A. From the words "practical absence."

Q. From the stipulation, that is all you know about what is claimed?

A. And I also know that if the process suggested in the stipulation and in the last published report of the Passaic Valley Commission be carried out, it will be impossible to prevent grease from being discharged from the sewer.

Q. I understand that, but so far as the claim is concerned, you do not get it from any publication or any official statement of the Commissioners in any way, do you, except in so far as it is contained in this stipulation?

A. It is an inference on my part from the fact so stated, from the proposition so stated.

Q. From what statements is it an inference?

A. An inference from the statement of what the project will be.

Q. And where do you get that statement?

A. Out of the contract with the Government.

2855 Q. That is the only place that you refer to?

A. I refer also to the report, the last published report of the Passaic Valley Sewerage Commission.

Q. And what date does that report bear?

A. I cannot trust my memory, but I think 1908.

Q. I show you this exhibit, and draw your attention to the fact that the date of it is the 14th day of April, 1910?

A. This is the stipulation, the contract.

Q. Yes, it is the stipulation, and the report you refer to is two years prior to that time, as you understand it?

A. As I understand it, yes.

Q. Now, in your opinion as an expert, does the same degree of purification become necessary in an effluent to be discharged into a river 40 feet wide, flowing through populated territory, and the City of Boston, as would apply to an effluent to be discharged at Robbins Reef in New York Bay?

A. At certain times of the year in this case at East Walpole a slightly higher degree of purification is necessary. At other times not so high.

Q. Not so high as would be required in New York Bay?

A. No.

Q. You think it is safer to discharge a less purified effluent into the Neponset at the point of discharge of your sewage disposal plant than it would be to discharge into the waters of New York Bay at Robbins Reef?

A. At certain times of the year, yes, at others, no.

Q. At what times of the year would it be safer to discharge a less purified effluent into the Neponset than at Robbins Reef?

A. At times when the stream flow is high, and the dilution great.

Q. Well, turning to your investigations of the oxygen contents of the waters of New York Bay, you say that the waters of the East River are on the safe side of the oxygen contents?

A. Just about.

Q. Now, what is that point that you think they have reached that is just about the safe side?

A. They averaged a point about 55% of saturation. I think if it went below, if it went to 50 or below, that conditions would demand a remedy.

2856 Q. And you do not think that they do demand a remedy at 55, is that it?

A. I have so stated.

Q. State it over again then?

A. I do not think that conditions demand a further purification at present.

Q. And how does it happen in your opinion, that the oxygen contents of the waters of the East River have been reduced to 55%?

A. By the discharge of sewage into the waters of the East River and New York Bay, Spuyten Duyvil, the Harlem River and the East River beyond Hell Gate.

Q. You have made observations of that discharge, have you?

A. Yes sir.

Q. Have you any idea what population is discharging its sewage into the waters that you have mentioned?

A. I have not the figures in my mind.

Q. Can you approximate it, do you think?

A. At least two millions.

Q. And in what condition is that sewage being discharged into the East River, treated in any way?

A. No.

Q. Crude?

A. Fresh sewage.

Q. When you testified to a discharge from the Passaic Valley Sewage district, with a population of sixteen hundred thousand, is that what you testified to?

A. Estimated population, yes sir.

Q. Is that your understanding of the present population?

A. No.

Q. What is the present population, if you know, it has been testified to?

A. I cannot carry all these figures in my mind. I should say something like half a million, thereabouts.

Q. And is it your opinion that the population that is discharging sewage into the East River and the waters you have named in connection therewith, has ceased to grow?

A. No.

Q. Can you approximate by estimation what the population of that district is likely to be when the population of the Passaic Valley district will be sixteen hundred thousand?

2857 A. I would not care to do it without some careful study. You might estimate roughly that it would grow 25 per cent every ten years at least.

Q. And given a sewage discharge from that increased population at the time when you estimate the Passaic Valley population at fifteen hundred thousand, what in your opinion would be the condition of the East River then as to oxygen content?

A. With the population increased, and the sewage increased correspondingly?

Q. Naturally?

A. And without any further purification of the sewage?

Q. Naturally?

A. The conditions would exceed a permissable limit.

Q. And irrespective of the question of whether or not there was any sewage discharged at Robbins Reef from the Passaic Valley?

A. Irrespective.

Q. Now, you have testified as to certain conditions which you say you believe will result from the discharge of the sewage at the proposed points by the Passaic Valley Sewer. First, taking up the question of Odor. How many inhabitants are discharging their sewage into the waters of the Upper Bay directly or indirectly, do you know?

A. I could look it up. I do not have it in mind.

Q. Can you approximate it?

A. Four millions, thereabouts.

Q. Is this stinking odor that you have testified as likely to result from the Passaic Valley sewage discharge noticeable in the waters of New York Harbor at this time?

A. In places, yes.
Q. Where?
A. In the Harlem River.
Q. Where else?
A. Along the wharves and places in Gowanus Canal, Newtown Creek, several places where the sewage and water do not mix readily.
Q. Anywhere else?
A. Well, sometimes along the Jersey shore, on the Jersey City side.
Q. When have you observed those conditions on the Jersey City side?
A. I might say periodically for the last four or five years.
Q. And at what periods?
A. Sometimes half a dozen times a year.
Q. You visited it?
A. Yes.
Q. At what points did you observe these conditions?
A. At the Pennsylvania Ferry, and the New Jersey Ferry.
2858 Q. That is the old Communipaw slips of the New Jersey Central and the Pennsylvania Ferry at Jersey City?
A. Yes.
Q. And those are the only places that you noticed that?
A. Yes sir.
Q. How much attention have you given to the water front of the Borough of Manhattan?
A. I have been all around it several times.
Q. Have you never noticed these offensive conditions as to odor on the Manhattan side of the river?
A. Occasionally, yes.
Q. Not periodically?
A. Periodically, yes.
Q. As frequently as you have observed them on the Jersey side?
A. Perhaps so, yes.
Q. More frequently?
A. Perhaps so.
Q. How far out from the slips have you observed this condition?
A. Almost entirely in the slips.
Q. How do you account for the absence of it beyond the slips?
A. The capacity of the water of the Harbor for self purification is sufficient.
Q. But it would not be sufficient at Robbins Reef for the discharge from the Passaic Valley Sewer?
A. It would not be safe with the discharge of 200,000,000 gallons and over, or 100,000,000 gallons and over.
Q. Are there 20,000,000 gallons or over discharged from sewers in the Borough of Manhattan?
A. Yes.
Q. More than that, more than 200,000,000 gallons a day from the Borough of Manhattan?
A. At least that.
Q. Considerably more?

A. That I could not say without looking it up.

Q. And after you get beyond the slips you get no signs of this anticipated disagreeable odor that you have testified in your opinion will result from the Passaic Valley sewage?

A. I would not say no signs; you do get some signs.

Q. How far are they?

A. All across the river.

Q. Have you detected it?

A. Not the odors but the signs.

Q. Have you detected the odor beyond the line of the slips?

A. Yes.

2859 Q. Where?

A. I said where the Gowanus Canal discharges into the river.

Q. Now, confining your testimony now to the Borough of Manhattan, how far out from the slips have you observed this disagreeable odor?

A. I have observed the odor perhaps 100 feet or 200 feet out from the pierheads. I have observed it from the stern of a tug boat.

Q. How far out from the pierheads?

A. From 100 to 200 feet.

Q. When did you make these observations?

A. In July 1911.

Q. Did you make a note of them?

A. I think so, yes.

Q. Is it in that note book that you have there?

A. No, in another one, a previous issue.

Q. That is in Boston?

A. Yes, sir.

Q. Now, the injurious effect upon the paint of vessels, Mr. Weston. Have you observed that result from the sewage of New York City at any point?

A. I have.

Q. Where?

A. Newtown Creek and Gowanus Canal and in the vicinity of Erie Basin, and in the Harlem River.

Q. And of what did your observation consist; what were the specific things that you observed?

A. The presence of lead sulphide on the surface of white lead paint.

Q. You assumed that was produced at the point where you saw the ships or boats?

A. Yes.

Q. You do not know as a matter of fact whether it was produced there or somewhere else?

A. Yes, I do, in a good many cases, because these ships or these steamboats with the white paint went from these places to clearer water and came back.

Q. So that you know that the most polluted places where they laid up were at the points that you observed?

A. Yes.

Q. What do you know about the oxygen content of the Gowanus Canal; do you know anything about it?

A. I cannot recall. It is very much depleted.

Q. Below the danger point?

A. I should say so yes.

2860 Q. Considerable?

A. It has been.

Q. What about Newtown Creek as to the oxygen content?

A. I have seen it, when it was below the danger point.

Q. The Harlem River?

A. I have seen it when it was below the danger point.

Q. Can you point out any place where this injurious effect on vessels has been observed by you except in places where the oxygen content of the water was reduced below the danger point?

A. I have only noticed it where my attention was called first to the character of the water, and looking about I observed its effect upon the paint surface.

Q. Now, Mr. Weston, assuming the discharge of sewage as you have assumed it from the Passaic Valley Commissioners Sewer at Robbins Reef, at what points do you think that the injurious effect with which we are now dealing upon the painting of vessels will be observed; what vessels will be affected injuriously in that respect by the discharge of the sewage at that point?

A. Vessels passing out of the main ship channel, through the main sip channel, back and forth.

Q. And they will in your opinion be subject to an appreciable injury in their paint by passing through the area of the discharge of the sewage?

A. I would not say that one passage through it would blacken the paint, but I think continued traffic through these waters would blacken the hulls of white vessels painted with lead paint.

Q. In an appreciable degree, do you think that would result?

A. Yes, as has occurred in the Passaic River. I think it is a matter of common knowledge that the excursion steamers along the wharves there are blackened because of the gases emanating from the Passaic River.

Q. What is the condition of the Passaic River at the points which you now have in mind with reference to oxygen content?

A. The oxygen is probably nearly exhausted, or not quite.

Q. Do you anticipate the practical exhaustion of the oxygen of the waters of New York Bay at Robbins Reef by the discharge of the sewage of the Passaic Valley Sewer?

2861 A. Expect the practical exhaustion of the oxygen from the sewage—I expect the sewage will spread over the surface of the water in a depth sufficient to have an appreciable effect on the harbor.

Q. Would it make an effect in any way comparable with that produced by the waters of the Passaic River at the points where you have observed vessels tied up?

A. Not in degree, but in kind.

Q. Any organic matter that is giving off gases will attack white paint, will it not?

A. Lead paint, yes.

Q. And vessels that ply through the waters of New York Harbor at the present time are appreciably affected, in your opinion, are they not, as to their painting by the condition of the water?

A. Possibly. I can give you an illustration of that. Silver is affected by the same gases. Silver has to be cleaned less frequently in the country than in the City, but it has to be cleaned. Yet, in the City, especially in a city where they burn coal, giving off a good deal of sulphate of hydrogen, it has to be cleaned very frequently.

Q. Well, now, Mr. Weston, just tell me if you think really that the effect upon the paint of vessels is really a matter to be considered in this connection from the discharge of sewage as proposed by the Passaic Valley Sewer?

A. It that were the only consideration, and the interest of a large community were involved as against that I would consider it of minor importance.

Q. Well, Mr. Weston, you have told us about some alternative plan of purifying the Passaic River. You have examined the Passaic Valley I think you said?

A. Yes.

Q. And you believe the waters of the Passaic River to be practically robbed of their oxygen at Newark, do you not?

A. Yes.

Q. And you believe it is a meritorious effort on the part of the defendants in this case to purify the Passaic River?

A. Decidedly.

Q. It is almost imperative in your opinion is it not?

A. Yes.

Q. Conditions are practically intolerable there, are they not?

2862 A. They are.

Q. Now, what was the alternative method that you suggested?

A. I suggested no alternative method.

Q. I thought you did. I thought you said you could place a disposal plant on the Newark Meadows?

A. I do not remember saying it.

Q. Won't you look at your notes toward the end of your testimony I think you read it?

A. Into Newark Bay.

Q. Don't you know that Newark Meadows are on Newark Bay?

A. Yes.

Q. That is substantially what I asked you?

A. I had no particular system to suggest; that is what I thought you meant in your question.

Q. Your plan is to discharge the effluent into Newark Bay?

A. I had no specific plan.

Q. What did you mean then in testifying in regard to Newark Bay?

A. I meant a system of sewage disposal located on Newark Bay.

Q. There would be an effluent from a sewage disposal plant, would there not?

A. There would.

Q. And Newark Bay would be the natural point of discharge?

A. Yes.

Q. What kind of an effluent do you think should be discharged into Newark Bay?

A. A partially purified effluent.

Q. Any better than this specified in the stipulation between the United States, the State of New Jersey and the Passaic Valley Sewerage Commissioners?

A. Yes, sir.

Q. Better than that?

A. Yes, sir.

Q. In what respect?

A. To have the organic matter oxidized, perhaps. To re-state that, first, I would suggest in a very general way the removal of a larger portion of the suspended matter than is contemplated in the stipulations.

Q. Excuse me for interrupting you. You would suggest the removal of the suspended matter beyond the point where it would not be visible?

A. I would not suggest that, no, because I believe that the scheme outlined in the stipulation will not accomplish that end.

2863 Q. You mean by that, do you not, that the specific devices which are described here will not produce the effluent which is stipulated for?

A. I do.

Q. That is your difficulty with this stipulation, is it?

A. Yes.

Q. Are you bearing in mind that the stipulation is that those specific devices will produce this result or requisite lawful additional arrangements will produce them. Have you that in mind as part of the stipulation?

Mr. O'Sullivan: I object to that question as calling upon this witness to determine what is lawful; asking this witness to pass on a judicial question.

The Commissioner: Note the objection of counsel for the Complainant.

A. I have in mind the devices mentioned in the stipulation, not of the additions thereto, of which I have no knowledge.

Q. There are additional devices which might be introduced into the system which would produce the results stipulated for?

A. Yes. In other words, if you would build a properly modelled disposal plant on Newark Bay near the mouth of the Passaic River or elsewhere, receiving the sewage from the Valley, you could discharge the sewage into Newark Bay.

Q. Safely?

A. Safely. Or into New York Bay.

Q. You do not think there should be a higher degree of purification for a discharge into New York Bay than there should be into Newark Bay?

A. I do.

Q. Why?

A. Because if discharged into New York Bay, already somewhat taxed, an additional burden would be placed upon the self purifying power of the water. If discharged into Newark Bay, not only will the same degree of purification result in a batter character of water discharged through the Narrows into the Bay, but it would place no burden for this purification upon New York Bay and its tributaries.

2864 Q. But would you mind directing your attention for a moment to the conditions above Newark Bay itself, and answer whether in your judgment taking those into consideration a higher degree of purification would be necessary or proper for New York Harbor than for Newark Bay?

A. I think there is a little more capacity for *for* self purification, or would be a little more capacity for self purification in Newark and New York Bays combined, provided the same character of effluent were discharged into it than if discharged into New York Bay alone.

Q. In other words you think that taken by itself the waters of Newark Bay can stand a more highly polluted effluent than the waters of New York Bay taken by itself?

A. I can answer that question only very generally, because I would have to take in the populations and flows and other data not in my mind at the present, would have to take that into account, but now Newark Bay receives partially purified sewage, and purified by the fermentation going on in the river itself, partially purified, yet very septic putrid sewage, yet the condition of the Bay itself below the Central Railroad of New Jersey trestle is fully as good as the condition of the New York Bay near Robbins Reef. Now, if that incoming sewage from the Passaic River were purified to such a degree that it would be nonputrescible I would consider that you could discharge more of it into Newark Bay than into New York Bay, although if purified to that degree it could discharge an almost unlimited quantity into either bay.

Q. So that if the municipalities, the territory located on the waters which are tributary to the Upper New York Bay purified their effluent to a condition to correspond with that required by this stipulation, there would be no trouble at all, would there?

A. I don't think, if I understand what you mean in your question correctly—I do not think the devices mentioned in the stipulation would ever satisfactorily purify the sewage from this whole Metropolitan District to such a degree that this harbor would be unobjectionable.

2865 Q. But bearing in mind that I have said nothing at all in my question about devices, but dealt entirely with the effluent as described in the stipulation, I ask you if all the sewage from the municipalities and territories discharging into the Upper New York Bay was rendered as unobjectionable as the effluent described in this stipulation, do you think any injury of any kind would result in the waters of New York Bay?

A. Yes, there is no provision in the stipulation, if I am correctly informed, as to that.

(Witness examines stipulation.)

A. (Continuing:) I will correct my answer.

If this stipulation be carried out by all the communities bordering on the Bay, said stipulation providing for no resulting injury, why, then, no injury would result.

Q. Now, you expressed a doubt as to what the Secretary of War of the United States might consider objectionable in the matter of deposits in New York Bay. Do you remember doing that?

A. Yes.

Q. Well, if there is an absence of visible suspended particles coming from the sewage of the Passaic Valley Sewer, in your opinion will there be objectionable deposits which could be objectionable to any one, even yourself?

A. If the effluent were clear, there would be no deposits from it.

Q. So if there are no visible suspended particles coming from the Passaic Valley Sewage in New York Bay, in your opinion will there be any deposits of any kind in New York Bay?

A. There might be some colloidal matter which would be invisible and would be precipitated.

Q. You think that would be objectionable?

A. Yes.

Q. In what respect?

A. It would form deposits like any other suspended matter. If they form deposits that would be objectionable naturally.

Q. Where would they form?

A. On tidal flats and in channels. Whether the Secretary of War would object to that amount of deposit or not, is something beyond my province to tell.

2866 Q. Would they be visible when the change occurred?

A. Yes.

Q. Then that would be visible suspended particles coming from the sewage?

A. It might be invisible at some time and then become visible.

Q. But it would still come from the Passaic Valley sewage would it not?

A. Yes, I suppose so.

Q. If there is absence of visible suspended particles coming from the Passaic Valley sewage, in your opinion will there be any deposits in New York Bay.

A. No.

Q. Then it would not be objectionable to you, let alone the Secretary of War, if there were none?

A. No.

Adjourned to September 4th, 1912, at 10:30 A. M.

Supreme Court of the United States, October Term, 1911.

THE PEOPLE OF THE STATE OF NEW YORK, Complainants,
against
STATE OF NEW JERSEY and PASSAIC VALLEY SEWERAGE COMMISSIONERS, Defendants.

Before James D. Maher, Esq., Commissioner.

CORPORATION COUNSEL'S OFFICE,
September 4th, 1912—10:30 a. m.

Appearances:

Dr. William J. O'Sullivan, Special Counsel for the People of the State of New York, Complainants.

2867 Adrian Riker, Esq., of Counsel for the Passaic Valley Sewerage Commissioners, Defendants.

Robert H. McCarter, Esq., Special Counsel for the State of New Jersey, Defendants.

Met pursuant to adjournment.

ROBERT SPURR WESTON a witness called on behalf of the Complainants, recalled for further examination, testified as follows:

Cross-examination by Mr. Riker (resumed):

Q. Mr. Weston, what study have you made of the harbor of Lynn?

A. I have made several trips to the harbor of Lynn and an investigation of it.

Q. In your trips to the harbor, how long did you stay?

A. I stayed I think one or two hours each time.

Q. What is the superficial area of the Harbor of Lynn?

A. It is rather hard to say because it is a V-shaped estuary.

Q. Have you ever tried to calculate it?

A. I have not.

Q. Have you ever seen any statement of its official area?

A. No, I have not.

Q. You never have looked for it, have you?

A. No.

Q. What is the maximum depth of the Harbor of Lynn?

A. I do not know.

Q. What is the water content of the Harbor of Lynn?

A. I do not know.

Q. What is the tidal prism of the Harbor of Lynn?

A. I do not know.

Q. You do not know much about it, do you?

A. I do not know any figures, no.

Q. Cannot you give me some idea of what the maximum depth is?

A. It is a shallow harbor.

Q. Do you compare that harbor with New York Harbor?
A. No.
Q. What rivers or streams flow into the Harbor of Lynn?
A. The Saugus River.
Q. How much is its flow per annum?
A. I have no idea, accurately.
2868 Q. What is the excess of water discharged from the Harbor of Lynn above that that comes in on the tides?
A. The water in the Harbor of Lynn above the point where the Saugus River runs, it receives very little water from the land, and consists almost entirely of a tidal prism which oscillates back and forth.
Q. What is the excess of discharge of water from New York Harbor over the amount received on tides?
A. The mean monthly flow of upland water into Upper New York Bay based upon the average monthly run-off from the combined drainage area of the Hudson and Mohawk Rivers is about 25,328 cubic feet a second.
Q. Have you calculated in gallons the amount of that run-off per day?
A. No, I have not.
Q. Do you know whether through the Narrows the larger or smaller amount than that named by you is discharged daily?
(No answer.)
Q. What are you using there, Mr. Weston?
A. I am using memoranda compiled from the evidence introduced into this case.
Q. Then you have no knowledge of your own at all except what is in evidence in this case of these facts and figures?
A. I am basing all my replies entirely on the evidence in this case, and my replies are qualified to the extent of their truthfulness and accuracy.
Q. Well, of your own knowledge, do you know anything about it?
A. I did not take the census determinations or make the gaugings of stream flows or compile the statistics.
Q. All you are attempting to do in answer to my question is, to repeat evidence already in this case?
A. I am, as far as figures go.
Q. What is the population which drains into Lynn Harbor?
A. About 60,000.
Q. Is the sewage treated in any way?
A. No.
Q. Is it discharged at the surface of the bay?
A. No.
Q. How deep is the discharge?
A. Four or five feet.
Q. Above what, high or low tide?
A. Four or five feet below low tide.
2869 Q. And is the discharge point of the sewers, or the discharge points of the sewers on the shore line, or in the Bay?
A. In the Bay.

Q. How far out?
A. Something over two hundred feet out.
Q. Is there a channel in Lynn Harbor?
A. Yes.
Q. How deep is it?
A. I do not know accurately.
Q. You have testified to some sea growths, some sea vegetation, what is the botanical name of this sea vegetation that you testified to?
A. Ulva latissima.
Q. And what is the common name for it?
A. Sea lettuce.
Q. That is the same thing that is found in Belfast Harbor?
A. Yes.
Q. Have you ever been to Belfast Harbor?
A. No.
Q. You have never seen it?
A. No.
Q. You do not know whether conditions there are similar to those in this harbor?
A. From reports I should say that they were different.
Q. In what respect are they different?
A. A large city, a different latitude. They are similar in being in a region where the rise and fall of tides is very high and it leaves large areas covered with a small depth of water at the time of the ebb tide, near the end of the ebb tide.
Q. What studies have you made on shell fish, Mr. Weston?
A. I have made very few studies on shell fish. I have analyzed some oysters at times for the presence of intestinal bacteria. I have made no extended investigations.
Q. Where are the shell fish cultivated in New York Harbor?
A. In New York Harbor?
Q. At what points?
A. Well, I think at very few points they are cultivated.
Q. Do you know anything about it?
A. Nothing except what has been introduced in evidence.
Q. Have you made any personal study of the subject of shell fish industry and growth in the Harbor of New York?
A. No, I have not.
2870 Q. What is the element in the discharge of sewage into New York Harbor which in your judgment affects the shell fish industry injuriously?
A. The presence of intestinal bacteria in the discharge.
Q. And you have testified that in your opinion the discharge of the Passaic Valley Sewage at Robbins Reef will injuriously affect the shell fish industry in the Harbor of New York, have you?
A. Yes.
Q. Why?
A. Because the sewage will be borne to all parts of the harbor wherever shell fish are, there they will become infected with the bacteria from the sewage.

Q. Has the oxygen content of the water anything to do with the question of the injury to the shell fish?

A. It probably has something to do with it, yes, as affecting the self purification of the Harbor.

Q. You are assuming now that there shall be sewage discharged into the Harbor?

A. There is now.

Q. You are assuming that that is to continue?

A. Unpurified sewage?

Q. Yes.

A. Assuming unpurified sewage, to discharge into the Harbor, the shell fish in the Harbor would be injured.

Q. Well, what system of purification that you know of, will destroy the intestinal germs in sewage?

A. Filtration through sand, and from a practical standpoint, filtration through trickling filters, preceded by proper sedimentation in each case.

Q. That removes the intestinal bacilli from sewage?

A. Not all, but to a great extent.

Q. Do you think it safe to discharge any intestinal bacilli into the waters of New York Harbor so far as shell fish raising is concerned?

A. Yes.

Q. You think it safe to discharge some?

A. Yes.

Q. What amount?

A. I am not prepared to give the amount, but I should think that could be readily determined by the results. If intestinal bacteria are found in the shell fish, why the methods employed are not adequate. I do not think anybody can say,—nobody can say.

Q. I want to know whether you can say?

2871 A. One bacillus in the Harbor of New York would be of no importance. You cannot spend a million dollars to save a life.

Q. How many would it be safe to discharge into New York Harbor?

A. I do not know.

Q. Do you think it would be safe to discharge the sewage containing intestinal bacilli from a population of something like 4,000,000 into the Harbor and still raise shell fish?

A. No.

Q. Now, in order to make the shell fish industry a safe one in the Harbor of New York, you have got to remove the present sewage that is discharged from the City of New York, have you not?

A. A portion of it anyway.

Q. What portion of it?

A. I do not know.

Q. How far is the proposed point of discharge of the Passaic sewer from the nearest oyster or shell fish bed that you know of?

A. The shell fish within one mile from the discharge.

Q. Where?

A. Upon the shore near the Pennsylvania wharf. I know there are shell fish there, because I have seen the men over there.

Q. How near is that to the sewage of Jersey City?
A. Quite near.
Q. You think that the discharge of the Passaic Valley sewer at Robbins Reef will add to the danger from contamination, add to that already existing from the sewage of Jersey City?
A. Certainly.
Q. How much?
A. In proportion to the amount of sewage discharged.
Q. How will it add to it?
A. By discharging the sewage.
Q. And how is the sewage to reach that distance?
A. Tidal currents.
Q. What is the population of Jersey City?
(No answer.)
Q. Don't you know?
A. I do not know off hand.
Q. It is a pretty large city?
A. Fairly large.
Q. Have you ever been in it?
A. Yes.
Q. What is the nearest point of discharge of a sewer from Jersey City to the oyster or shell fish beds that you testified to at the Pennsylvania wharves?
A. The nearest point?
2872 Q. Yes.
A. The point I meant was right off the division line between Jersey City and Bayonne.
Q. Well, what is the nearest sewer discharge to that point?
A. The nearest I know of is within two miles. There may be others.
Q. What is that one that you think is the nearest, two miles from that point?
A. Very near Ellis Island along the shore between the place called Black Tom and Ellis Island, in shore.
Q. From what city does it come?
A. Jersey City.
Q. That is the nearest, is it?
A. That is the nearest one that I know of personally.
Q. Where is there any other shell fish industry located in the harbor that you know of?
A. The clams are taken all around the shore of the whole bay.
Q. Along the New York front?
A. No, not on the New York front.
Q. The Brooklyn front?
A. Wherever the wharves do not prevent, along the beach. I have seen men doing it.
Q. And in your judgment those shell fish are fit to eat?
A. I would not eat them.
Q. Under the present conditions you would not eat them?
A. Under present conditions.

Q. What additional injury do you think they would get from the Passaic Valley sewer discharge, if they are not fit to eat now?

A. An increase in the amount and number of bacteria.

Q. Being dangerous now, they would be more dangerous?

A. More dangerous.

Q. They are not now in a condition in your judgment, when they are fit to eat?

A. No, sir.

Q. Now, you have given some evidence of your judgment, your opinion as to the effect upon shipping from the discharge of the Passaic Valley Sewer at Robbins Reef. Will you state again what in your judgment will be the effect upon the shipping?

A. The turbidity, grease and other matter would make the
2873 waters of the Upper Bay unpleasant for commerce, and tend to make excursions on the harbor unpopular, thereby creating noticeably disagreeable conditions in the largest port of the country, consequently lessening its prestige and depreciating the value of the bay for recreation purposes.

Q. How extended an area will the turbidity cover, in your judgment, taking it first say, 2 years from now, with a population approximately of 500,000 discharging at that point?

A. Approximately 500,000?

Q. Yes, that is the present population of the Passaic Valley, is it not?

A. No, sir.

Q. What is it?

A. The figure given in the report of the Passaic Valley Sewerage Commissioners is 734,000, if I remember correctly.

Q. Then you have revised your knowledge since yesterday; you testified yesterday it was about 500,000?

A. I said at least 500,000.

Q. Now you have verified the figures since then?

A. I have.

Q. And found out what the actual population is?

A. In giving my testimony in the beginning yesterday, I said the population was estimated for 1911 at 702,400.

Q. Now, take that amount as the population, and what area of turbidity will you expect at Robbins Reef?

A. 3 to 5 square miles.

Q. And grease, how far will that extend?

A. That would extend practically over the whole—in places, over the whole bay.

Q. And the color, how far would that extend?

A. The color would extend about three fifths as far as the turbidity.

Q. The turbidity is not marked by any color, is it?

A. By color, I mean the dissolved color; by turbidity, the suspended matter.

Q. What model do you refer to?

A. By color, I mean the color which the water would have if the suspended matter were removed by filtration.

Q. And what color would that be?

A. That would be the color which would be imparted to the water by dyes, by the presence of iron compounds due to fermentation and putrefaction.

Q. And you fix that at about two thirds of the area of turbidity?

2874 A. Two thirds, that is perhaps a little high; three fifths would be better than two thirds.

Q. How do you reach that proportion?

A. From observations of the outlets of other sewers.

Q. Does it depend upon the local conditions of the territory which is served by the sewers?

A. Somewhat.

Q. Well, if there are no dye stuffs and no iron, is there any color?

A. No.

Q. Then it does depend entirely, does it not, upon the local conditions?

A. It depends entirely upon the character of the sewage and the character of the harbor in which the sewage is discharged.

Q. What is the effect to be expected from these elements in the waters of the harbor upon the shipping of the great City of New York?

A. I have already stated.

Q. Well, state it over again?

A. It would tend to make the harbor more unpopular for holiday excursions as time went on.

Q. More and more unpopular for holiday excursions as time goes on?

A. Yes.

Q. And the total population to be served by this sewer, do you know what that is, the Passaic Valley sewer?

A. 734,000 given in the Passaic Report.

Q. And the total ultimate population to be served?

A. 1,649,440.

Q. Now, where is this excursion population located that you think will be so injuriously affected by the discharge of sewage at Robbins Reef from this sewer?

A. In the district, New York and New Jersey, contiguous to the waters of New York and Newark Bays.

Q. Well, where is the majority of that population located now?

A. In New York City.

Q. Have you made an observation of the slips of the City of New York, more particularly of the Borough of Manhattan?

A. I have.

Q. What is the condition of the waters in the slips as you have observed it?

A. Not altogether good; in some of them quite bad.

2875 Q. Well, what study have you made of the sewers of the Borough of Manhattan for example?

A. The sewers themselves?

Q. Yes.

A. None at all.

Q. Do you know where they discharge?

A. At the *foots* of the street mostly.

Q. With reference to the slips where do they discharge?

A. They generally discharge inland: inside the pier head line.

Q. And have you marked any noticeable effect upon the excursion traffic of New York from this foul condition of the slips at which the excursion boats start?

A. I have heard a good many complaints about it.

Q. What would you say as to the relative importance of a crude discharge into a slip, and the discharge of the Passaic Valley sewer at Robbins Reef, so far as the excursion traffic is concerned?

A. The discharge of the sewage from the Passaic Valley sewer would be far more objectionable because it would be putrid. That discharge in the slips of New York is fresh sewage unputrefied. It goes into the harbor from a great many outlets, and is well mixed with the waters of the river, and is disposed of in the presence of oxygen, and is disposed of in a comparatively unobjectionable manner. The discharge of a large amount of putrid sewage into the harbor at one point would be far more objectionable than if discharged from hundreds of sewers at as many points in a large body of water along a large coast line.

Q. And you think that the water there will be more objectionable because of the turbidity and grease and color than it is in the slips into which the sewers of New York discharge sewage?

A. I said turbidity, grease and other matters.

Q. What are the other matters?

A. The other matters would be odoriferous gases.

Q. That is a question of odor, not of sight?

A. Both; there would be turbidity.

Q. Can you see the odoriferous gases?

A. The odoriferous gases are a question of smell, not of sight.

2876 Q. Now, I desire to ask you whether in your opinion, the turbidity and grease and color, being phenomena appealing to the sight, will be as objectionable at the point of discharge of the Passaic Valley sewer as they are in the slips of the City of New York into which crude sewage is being discharged from the sewers of the City of New York?

A. Under what conditions of discharge?

Q. Under the conditions which you have been assuming in your testimony as to the effect of this discharge on New York Harbor?

A. Assuming the construction mentioned in the stipulation?

Q. Assuming the conditions under which you gave your direct testimony, Mr. Weston, if you please?

A. I do not think the conditions are at all comparable. Here is one sewer discharging everything at one point. Here are a number of sewers discharging a little at each point. If all the New York sewage were discharged at one point, assuming the sewage to be as at present, the offensiveness to the sight might be more than the proposed Passaic Valley project. On the other hand, the Passaic

Valley project does not contemplate any such conditions. I do not see how you can compare one with the other.

Q. What I want you to compare is the actual present conditions as you have observed them, in the slips about the Borough of Manhattan, with the conditions which you anticipate will exist in New York Harbor at Robbins Reef when the Passaic Valley sewer is in operation, so far as turbidity, color and grease are concerned?

A. There would be more grease at the Passaic Valley outlet; many many times more; much more color.

Q. Yes, and much more turbidity will there be?

A. In times of storm about the same.

Q. Well, at times of calm?

A. At times of calm the discharge from the Passaic Valley sewer, would be far more turbid.

Q. I want you now to tell me what your judgment is as to the surface indications, the things that you can see?

A. Floating matters?

Q. No, the turbidity, color, grease and floating matter, if
2877 there is any floating matter that you anticipate at the point of discharge of the Passaic Valley sewer, as compared with the present actual condition of waters in the slips, about the Borough of Manhattan?

A. You mean purely visual?

Q. Certainly.

A. The discharge from the Passaic Valley sewer would be far more noticeable.

Q. On the surface?

A. On the surface.

Q. Than are the same things in the slips about the Borough of Manhattan at the present time?

A. Certainly.

Q. Do you know how many sewers discharge into slips about the Borough of New York?

A. No more than that there are several hundred.

Q. And you know they discharge crude sewage into the slips?

A. Crude fresh sewage.

Q. And street washings?

A. Yes.

Q. Untreated in any way?

A. Untreated in any way.

Q. Have you heard the condition of the water in the slips described at any time as crude sewage?

A. No.

Q. You do not recognize in your observation of these slips the water as consisting of crude sewage?

A. I know that the sewage is discharged in an untreated condition, fresh.

Q. Do you think that fresh sewage produces a condition of visible floating matter less objectionable than stale sewage?

A. I think that fresh sewage, floating matter and all is less objectionable than stale sewage without floating matter.

Q. I am asking now as to the effect to the eye, in your judgment. Do you think that so far as the effect on the eye is concerned, that crude sewage, fresh sewage is less or more objectionable than stale sewage?

A. Stale sewage unsettled or settled?

Q. Well, stale sewage as to which you have already testified in answer to some of my questions?

A. It would be more disagreeable to the eye than fresh sewage.

2878 Q. It would be?

A. Yes.

Q. In fresh sewage you observe the phenomena of floating feces at times?

A. Yes.

Q. Did you ever see that in stale sewage?

A. Yes.

Q. You do?

A. Yes, unless it is screened or settled.

Q. Do you see that in stale sewage, the staleness of which results from traversing a long distance of sewer pipes?

A. No.

Q. You never see that?

A. You never see that.

Q. You would not see that at the discharge of the Passaic Valley sewer at Robbins Reef?

A. You would not.

Q. Have you ever happened to notice that in the slips of New York?

A. I have.

Q. Do you consider that objectionable to the sight?

A. I do.

Q. Very?

A. Yes.

Q. More so than any other phenomenon, so far as the eye-sight is concerned, that you can think of?

A. Not more than the odor.

Q. I am talking about the sight, Mr. Weston, you do not get the odor with your eyes, do you?

A. No.

Q. Now you think that excursion traffic which puts up with the conditions of the piers and slips of the Harbor of New York will be affected by passing through a field of affected water injuriously?

A. It will be very much affected injuriously by passing through a field of stinking sewage.

Q. But it would not be interfered with seriously by being tied up in the slips of the City of New York into which crude sewage containing feces is discharged?

A. I think the time will come when commerce will be affected, commerce from the slips will be affected but that will be the time when the dissolved oxygen content is lowered and putrefactive conditions begin.

Q. Do you think commerce is injuriously affected by the condition of the waters in the slips of the City of New York?

A. In view of the fact that those things are very carefully screened from view, the fact that people board the ships through long covered piers and do not get a sight, as a rule, of the water, until they embark, I should think that would hardly hold in this case, that objection.

2879

Q. You think that people in ferry boats and excursion steamers do not get any view of the water in the slips, do you?

A. People on ferry boats do.

Q. What about excursion steamers?

A. I said I think their view is screened, as a rule, until they embark.

Q. Therefore it is safe to pollute the water of the slips to any extent, as far as commerce is concerned?

A. Not at all.

Q. Well, I want to know whether in your opinion, conditions of the shore waters of the City of New York, particularly of the Borough of Manhattan, have injuriously affected shipping interests of the great City of New York?

A. Not that I know of.

Q. And you do think that the discharge of the sewage at Robbins Reef from the Passaic Valley will injuriously affect it?

A. Most certainly.

Q. To what extent, in what way?

A. Well, I should not care to go down to Coney Island, for instance, if I had to traverse a field of smelling sewage.

Q. You would not object to embarking in the slips in New York, into which crude sewage from the City of New York is being discharged, and stay there until the boat puts off?

A. Not so long as the oxygen content in the water was sufficient to prevent putrefaction.

Q. And what is the amount of oxygen necessary for that purpose?

A. I have placed it at 50 per cent. of saturation.

Q. And what is the average oxygen content at the present time at Robbins Reef?

A. Something more than that.

Q. Tell me how much. You testified to it. Get at it and let me see what it is?

A. About 72 per cent. saturation.

Q. Have you made any investigations of the oxygen content in the slips about the Borough of Manhattan?

A. I have not.

2880

Q. Well, at the mouth of the Hudson, what is the average oxygen content at the present time?

A. 55 per cent.

Q. Well, have you determinations of the oxygen close in to the shore at that cross section on the Manhattan side?

A. I think so.

Q. Will you look that up?

A. Somewhat lower than that, I know.

Q. How far out were those samples taken?
A. The first sample was 200 feet off Pier A, the next one, one quarter way across.
Q. Did you get the averages of the samples taken at that point, 200 feet off Pier A?
A. Yes.
Q. What is it?
A. Beg pardon, I have not the individual analyses here.
Q. Well, you still think, however, that the nearer to the Manhattan shore you come, the less the oxygen content at that cross section?
A. It varies very little between those points. I think about 2 per cent.
Q. How do you account for that variation?
A. It might vary that amount in the error of the sampling or the error of the analysis, it might vary two per cent.
Q. What other explanation might there be?
A. I do not think there is any other explanation.
Q. Would you not think the fact that crude sewage is being discharged all along the shore line directly into the water would have anything to do with explaining the decrease in the oxygen as you approach the shore of New York?
A. There might be some decrease at the surface; at the bottom there is practically no difference.
Q. Why is that?
A. The sewage tends to spread out on the surface.
Q. And sewage which is discharged at the surface is very apt to stay there, is it not?
A. Sewage discharged is very apt to go to the surface.
Q. I say sewage discharged at the surface of the water, is very apt to stay there, is it not?
A. Yes.
Q. Don't you know that the sewage of the City of New York is practically all of it discharged at the surface of the water?
A. No, I do not.

2881 Q. How much below the surface do you know that it is being discharged at any point?
A. I know that a great deal of it is discharged below low water.
Q. How much below low water?
A. I have no means of knowing.
Q. You have not investigated that subject?
A. I have not.
Q. And you have made no attempt to determine the oxygen content of the water in the slips about the Borough of Manhattan?
A. Not at all.
Q. Do you think it is as high as 55 per cent?
A. No.
Q. How low do you think it is?
A. I have no idea.
Q. Below 50 per cent?
A. Yes.
Q. Below the danger line then?

A. I should say so.

Q. Well, now, starting with 72 per cent. of oxygen at Robbins Reef at the present time and assuming a discharge of sewage from a population of 750,000 inhabitants in the Passaic Valley, what will the result be in your judgment on the dissolved oxygen in the waters about Robbins Reef?

A. It will be all gone.

Q. All gone?

A. Practically.

Q. To what distance from the points of discharge of that sewage?

A. That I could not say.

Q. Cannot you approximate it?

A. Not off hand, no.

Q. Well, there will be none, in your judgment, in the sewage as it is discharged into the water at a depth of 40 feet?

A. None in the sewage.

Q. No-e in then sewage?

A. No.

Q. Now, to what distance from the points of discharge of the sewage into the waters of the bay, will the oxygen be abstracted?

A. It is a question I cannot answer without a great deal of thought and study. It is contingent on so many factors, such as the direction which this sewage field would take with the tide. For example, there might be a flood tide and a strong southeast wind, which would bring that sewage field well up into the Hudson River, and the water south of it, might at that time be comparatively free from the effects of this sewage field. Another day, or at another time on the
2882 same day, the reversed conditions might take place.

Q. You think in the surface waters of New York Bay for an appreciable area, the oxygen content of the water will entirely disappear after this sewer is in operation?

A. Practically disappear.

Q. Just what is "practically"?

A. Well, it would be less than 5 per cent. saturation.

Q. Less than 5 per cent. saturation, and for what area?

A. For an area at least half a mile square.

Q. That is with 750,000 inhabitants. Now, Mr. Weston, what is the largest sewer that discharges into New York Harbor at the present time, so far as you know?

A. I do not know absolutely.

Q. Have you any idea at all, what it is?

A. I could not say without refreshing my memory.

Q. What is the size of the Bronx Valley Sewer, do you know?

A. I could not say. It is a large sewer.

Q. Do you know what the population is that it serves?

A. Not off hand.

Q. Can you approximate it?

A. I would not attempt to do that. I have made no study of the Bronx Valley sewer.

Q. Do you know of any other large sewers serving the Greater City of New York, discharging into the waters of New York Harbor?

A. I do not know anything about the sewers with reference to the population which they serve.

Q. Do you know that there are sewers that serve as many as 750,000 inhabitants?

A. I do not think that there are.

Q. Do you know?

A. I am pretty sure there are not.

Q. Do you know whether there are sewers that serve a population of 500,000 inhabitants?

A. I do not know anything about the areas served by any sewer in New York, or the population served by any sewer.

Q. You have observed the conditions in Boston Harbor, I think you told us yesterday?

A. Yes, sir.

Q. Now, the Deer Island outlet, what population does that serve?

(No answer.)

2883 Q. Don't you remember?

A. I would rather compute it.

Q. You live and practice your profession in Boston?

A. Yes, sir, but I do not carry all the statistics of the City in my head. Roughly 680,000.

Q And is the sewage there discharged fresh, stale or putrid?

A. It is stale sewage.

Q. What is the length of line of sewage discharging at that point as compared with the Passaic Valley sewer?

A. Part of it is—all of it shorter.

Q. How much?

A. Well, I think the longest—the greatest distance is less than 10 miles of the——

Q. What?

A. Of the Metropolitan Sewer. I beg pardon—less than 20 miles.

Q. What is the extreme length of the proposed Passaic Valley sewer?

A. Something over 26 miles.

Q. And what will be the state of the sewage discharged at Robbins Reef as compared with that discharged at Deer Island?

A. It will be more putrid.

Q. You do not call the sewage discharged at Deer Island putrid?

A. Sort of half way between stale and putrid sewage.

Q. Somewhat putrid?

A. Somewhat putrid, yes.

Q. Have you determined the oxygen content of the waters of Boston Harbor about the Deer Island outfall?

A. I have.

Q. Is the oxygen all gone?

A. It is near the outlet, yes.

Q. How near the outlet?

A. I have not my notes here, I could not say.

Q. How much below the surface of the water is the outlet?

A. It is near the surface.

Q. What treatment does the sewage that is discharged at Deer Island outlet receive?
A. None, except screening.
Q. What kind of screening?
A. Coarse screening.
Q. What mesh?
A. I do not know.
Q. And what does that screening serve to take out of the sewage?
A. The large coarse suspended matter.
2884 Q. Paper?
A. Paper, orange peel and so forth.
Q. Things that are more properly called garbage, are they not, than sewage?
A. You could call it garbage—a piece of board would not be garbage.
Q. Orange peel?
A. Orange peel.
Q. Watermelon rinds?
A. Yes.
Q. Muskmelon rinds, things like that, those things would be taken out, would they?
A. Yes.
Q. What effect has that discharge at Deer Island had upon the shipping of Boston Harbor?
A. It has made the trips to that portion of the Harbor less attractive.
Q. Has it interfered with any of them?
A It has interfered with some people that I know of going there.
Q. Have any trips been taken off by reason of it that you know of?
A. No.
Q. Don't you think, Mr. Weston, that your anticipation of injury to shipping from the discharge of the sewage at Robbins Reef is a little fanciful?
A. I do not.
Q. You think that there will be a real interference with traffic by water over the Bay of New York by reason of this discharge, do you?
A. I think so.
Q. Now, what study have you made of the bathing beaches and facilities about the harbor of New York?
A. None.
Q. You testified that in your judgment this discharge would injuriously affect the bathing facilities and pleasure pursuit?
A. Where the bathing places are located. I thought I said bathing facilities.
Q. Where are the bath houses located, in your observation?
A. I cannot give the number of the street. There have been some in the East River, there have been some in the North River, there have been some along the shores of Brooklyn.
Q. They are public bathing places?
A. Public bathing places.
Q. How far out from the shore?

A. Near, quite near.
Q. A good many of them?
A. Some of them are near.
Q. And were there a good many of such bathing houses
2885 along the shores of Brooklyn and Manhattan?
A. Not so many as there ought to be.
Q. That is within the domain of speculation. I asked you whether there are a good many.
A. I should say there were a very few compared with the population.
Q. About how many?
A. I have no idea.
Q. Do you know how many inhabitants of the Borough of Manhattan use the public baths?
A. No.
Q. Well, do you think that those baths, bathing places, will be injuriously affected by the discharge of the proposed sewer of the Passaic Valley at Robbins Reef?
A. I do.
Q. How near are they to the mouths of the sewers of the City of New York?
A. Very near.
Q. At the present time?
A. Yes.
Q. And those sewers you know are discharging not far below the low water mark in any case?
A. Yes.
Q. And you think that the people who would enjoy the bathing in waters of that character would be prevented by the influence of the discharge of the sewage as proposed at Robbins Reef from the Passaic Valley sewer?
A. I cannot answer the question directly.
Q. What do you think about it?
A. I think this: that the mere fact that the baths may be dangerous now is no reason why added infectious material would not increase the danger.
Q. Well, to what extent do you think that the discharge of the Passaic Valley sewer at Robbins Reef would add to the infection?
A. To this extent, that if all the sewage proposed under the Passaic Valley project were discharged at a point near Robbins Reef, and if no sewage were discharged from Manhattan Island, there would be some danger from the discharge of the Passaic Valley sewage to bathers at least along the shores of the Lower City, and I might add the shores of Brooklyn.
Q. That condition is rather imaginary, is it not?
A. That is imaginary, yes. It might come about by construction. It has been done in other cases. For example the City of
2886 London used to discharge all its sewage into the Thames. That is all intercepted and taken down to the Lower Thames and discharged near the sea.
Q. Confine your attention now to the actual existing conditions. Do you think there will be any perceptible increase to the danger

to bathing along the shores of Manhattan and Brooklyn from the discharge of the sewage as proposed at Robbins Reef outlet?

A. There will be added infected material, and an added danger.

Q. How far is the Robbins Reef proposed outlet from these bathing places along the shores of Brooklyn and Manhattan that you have observed?

A. 4 to 7 miles.

Q. Well, now, where are there other bathing places that you have observed which you think will be injuriously affected?

A. Along Gravesend Bay and Coney Island.

Q. How far from Robbins Reef are these beaches?

A. The same distance.

Q. About 7 miles?

A. 4 to 7 miles; yes, sir.

Q. The Gravesend Beaches that you have observed, are there local sewers discharging into Gravesend Bay?

A. I cannot remember; I think there is one.

Q. Have you made any examination of the data which is assumed to be contained in the exhibits which you said you have considered?

A. Yes.

Q. With reference to the oxygen content of the waters of Gravesend Bay?

A. I studied the determinations made in the vicinity of Gravesend Bay.

Q. Not in Gravesend Bay?

A. None up in the Bay, up on the shores.

Q. How near to the bathing places that you refer to are these oxygen determinations that you have studied?

A. Made within a mile of them.

Q. What was shown as to pollution by those oxygen determinations?

A. On the flood tide, there is very little pollution. On the ebb tide, the degree of pollution approaches the limit.

Q. That is at present, is it not?

A. Yes.

Q. Without any discharge from the Passaic Valley Sewer at Robbins Reef, that is the condition at present?

A. Yes.

2887 Q. Now, the bathing beaches of Coney Island. Do you know how Coney Island is sewered?

A. No; I do not.

Q. Do you know whether it is treated in any way?

A. I do not.

Q. Have you made any determinations or have you seen any determinations of oxygen content of the waters about the beaches of Coney Island?

A. I have not. Beg pardon. With the exception of one in Ambrose Channel, which is near there.

Q. Well, as to that, how was the water with reference to contamination?

A. Only slightly contaminated; slightly polluted.

Q. Only slightly contaminated, although the sewage of the City of New York and its arge population finds its way indirectly finally through that channel, does it not?

A. Yes.

Q. And you think that the discharge of this sewage proposed at Robbins Reef will materially affect the contamination of waters at the beaches at Coney Island?

A. Yes, and it must be stated also that Ambrose Channel is not Coney Island.

Q. Do you think that the sewage from the four or five millions of inhabitants of the Greater City of New York contaminates and renders dangerous the bathing at Coney Island?

A. I do not think the contamination at present makes the bathing dangerous.

Q. Do you know what the population, in a rough, general way, is, of the Greater City of New York?

A. About 4½ millions.

Q And you think that the sewage does not injuriously affect the bathing at Coney Island?

A. I think it makes it unpleasant at times, not necessarily unhealthful.

Q. Well, why is it not necessarily unhealthful?

A. It is possible to bathe in water of some degree of pollution without receiving a very large dose of infected material if one is careful.

Q. Well, what is the danger, in your judgment, from bathing in polluted water?

A. The swallowing of it.

Q. Swallowing the water?

A. Swallowing the water.

2888 Q. Not the water itself, you do not mean that, do you?

A. Yes.

Q. It is dangerous to swallow water, is it?

A. Polluted water, when you are bathing in it, yes.

Q. What is the element in the polluted water that is dangerous to swallow?

A. Intestinal bacteria.

Q. Not necessarily the bacteria of the alimentary canal?

A. The bacteria of diseases of the alimentary canal.

Q. Particularly the colon bacillus?

A. Particularly the typhoid bacilli.

Q. And you think while the sewage of the population of the City of New York may make it unpleasant to bathe in the waters at Coney Island, it does not necessarily make it dangerous?

A. It may make it dangerous; it does not necessarily do so.

Q. And you think that the discharge of the water—the sewage at Robbins Reef will make it necessarily dangerous?

A. Make it unpleasant and possibly dangerous.

Q. How does it happen that that sewage will make it dangerous when the sewage from four or five millions of inhabitants does not make it dangerous?

A. The discharge point is nearer the beach.
Q. How much nearer?
A. Three miles on the average.
Q. Three miles on the average nearer to the beach?
A. Yes I wish to say that the danger is a possible one.
Q. A little fanciful also, is it not?
A. It is not.
Q. Now, in your direct testimony and in your testimony so far given on cross examination, what character of discharge have you been assuming?
A. I have been assuming that there would be discharged from the Passaic Valley sewer sewage which would be screened through coarse screens, also through fine screens, having one quarter inch meshes, settled in grit chambers to remove the coarser evidence of suspended matters and given a short period of sedimentation in larger sedimentation basins; then pumped through a tunnel about 5.25 miles long into the upper Bay at a point near Robbins
2889 Reef and discharged over an area of about 3.5 acres through a number of outlets.
Q. Well, that is a discharge produced in a certain way. Now will you describe the effluent which you are assuming will be thus discharged?
A. I assume that the effluent thus discharged will be highly turbid, especially with grease from the wool scouring and silk scouring industries. At times it will contain a large amount of suspended clay, not removed by sedimentation. Also contain about 66 per cent. of the suspended matter originally present in the sewage. It will contain a large amount of color emanating from the dye stuffs and spent dye liquor discharged into the stream, especially from the City of Paterson. It will contain the dark colored matters produced by the action of sulphuretted hydrogen upon the iron contained in the sewage. It will contain a large volume of odoriferous gases produced by the decomposition of the sewage in the settling tanks and in the sewer. It will also contain a large amount of fats and greases not acted on by the decomposition, and discharged with the sewage at Robbins Reef. It will have a specific gravity slightly higher than water, and will have a temperature somewhat warmer than water.
Q. Now, on what do you base those conclusions?
A. I base those conclusions on my experience, analytical experience, and my observations of sewages from other cities. My experience in connection with the disposal of manufacturing wastes of textile industries and particularly upon my analyses of the sewage from the Metropolitan Sewer of Massachusetts.
Q. Where have you had an observation or an opportunity to observe sewage treated in the manner which you have described, and discharged in the manner that you have described; do you know of any such plant?
A. I do not know of any such plant which has all of those units arranged in the same way. I know of plants where the effect of each unit has been noted; where I have noted the effect of each unit

Q. Now, do you know who made the specifications of the specific appliances which are mentioned by you as contained in the stipulation?

2890 A. I cannot say surely.

Q. Do you know Colonel Black?

A. I do.

Q. He is an engineer of standing?

A. Yes, but not with much experience on sewage disposal.

Q. Do you happen to know the man who was associated with him in the preparation of the specifications?

A. I would not be sure.

Q. You do not know that he has testified in this case?

A. I would not be sure. I do not know who prepared those specifications.

Q. And in your opinion the person who prepared them and was responsible for their going into the specifications either was ignorant or intended to deceive the government of the United States, is that it?

A. My opinion is that he did not know, if he said that the results in the stipulations could be obtained, what effect the devices would produce, for those devices cannot produce the effect stipulated.

Q. Well, that is a matter of opinion, is it not?

A. That is my opinion.

Q. That is only your opinion?

A. That is my opinion.

Q. That is your opinion?

A. Yes, sir.

Q. You know what opinions of other experts differ from yours?

A. That may be.

Q. You offer your opinion only for what it is worth?

A. I think that is a quite usual opinion.

Q. Well, then, you have not assumed in your testimony the effluent which is described in this stipulation?

A. I have assumed the effluent which those devices would produce.

Q. Won't you answer my question, Mr. Weston. I asked you whether you have assumed the effluent which is described in this stipulation?

A. I have not assumed an effluent from which there will be absence in New York Bay of visible suspended particles coming from the Passaic Valley sewage, because I believe that the project cannot furnish such a sewage. Second, nor one from which there will be an absence of deposits, for I believe that deposits will be produced in the harbor as the result of the discharge of this

2891 sewage. Nor that there will be absence in New York Bay and its vicinity of odors due to the putrefaction of organic matters contained in the Passaic Valley sewage thus discharged, because I believe the sewage will smell bad. Fourth, that there will be practical absence on the surface of New York Bay of any grease or color due to the discharge of the Passaic Valley sewage, for I

believe there will be an unusual proportion of gas in sewage treated as described in this stipulation. Fifth, that there will be no injury to the public health which will be occasioned by the discharge of said sewer into the Bay of New York in the manner proposed and no public or private nuisance will be created thereby, because I believe that if treated as described in the specifications there will be a danger to public health because sewage if so treated, treated in the manner proposed, will be a public or private nuisance.

Q. Then after going into detail, I suppose you can answer my question that you are not assuming an effluent such as is described in this stipulation. Cannot you answer that question; that is the question I ask you?

A. I cannot answer the question honestly because I believe the means to produce that effluent describe one kind of effluent and the effect stipulated to be produced describes another.

Q. Cannot I get you to answer my question yes or no? I ask you if in your testimony you have assumed an effluent such as is described in this stipulation, yes or no?

A. If you will confine your question to those certain paragraphs of that stipulation, I can answer yes.

Q. Is there any description of effluent except those specific paragraphs contained in the stipulation?

A. None of the effluent but of the devices.

Q. Very well, I ask you about the effluent. I am not asking about the devices. I am asking you whether you are assuming an effluent such as is described in this stipulation in the testimony which you have given in this case?

A. I am not assuming an effluent like that described in the paragraphs which I have just mentioned.

2892 Q. Please assume such an effluent and state what in your opinion will be the result upon the various industries and specifications which you have testified to?

A. It will be discharged without any danger.

Mr. Riker: That is all.

Redirect examination by Mr. O'Sullivan:

Q. Is it feasible to secure such an effluent, Mr. Weston, by the devices described?

A. Absolutely impossible.

Q. Mr. Weston, Mr. Riker asked you relative to the area of Lynn Harbor, the population of Jersey City and matters of that kind. Do you burden your memory with the statistical data and trust it?

A. I do not.

Q. You were asked relative to sewage discharged on the surface remaining on the surface. No matter where sewage is discharged, where will it be found?

A. On the surface, especially in salt water, which is heavier and colder than sewage.

Q. Mr. Riker asked you some questions involving the fact that the conditions in the Passaic River were intolerable. I ask you if

the Passaic Valley trunk sewer project would transfer these intolerable conditions to New York Bay?

A. It would.

Q. You were asked some questions relative to whether or not that discharge would affect commerce or shipping interests. Do the conditions now described as intolerable in the Passaic River affect the shipping interests?

A. Yes, sir.

Q. Directing your attention to Complainants' Exhibit No. 168, I would ask you what in general terms is the shape of Manhattan Island?

A. A long narrow island about 13 miles long, 1 mile broad at the upper end and 2 miles broad at the lower end.

Q. How do the sewer outfalls discharge?

A. As a rule at the foot of the streets.

Q. And on each side of the island?

A. They are.

Q. What condition is that sewage in at the point of discharge?

A. Very fresh.

2893 Q. Approximately about how fresh, half an hour, whatever the time is?

A. Some of it is a few minutes old and all of it is probably less than four or five hours old.

Q. You have used the terms "crude, stale, septic, putrid" in your answers relative to sewage. Will you define what you mean by these terms?

A. By "crude sewage" I mean sewage untreated by any method of purification, either screening, subsidence or filtration, or any other method.

By "stale sewage" I mean sewage which has so far undergone destructive changes that it is robbed of its oxygen.

By "putrid sewage" I mean sewage in which not only has the oxygen vanished from it, but further destructive changes have gone on, producing hydrogen sulphide and other sulphurous gases, notably the gases of decomposing feces.

Q. Do you make any distinction between these terms "septic" and "putrid"?

A. "Septic" and "putrid" are synonymous terms.

Q. What do you mean by "fresh sewage"?

A. I mean sewage which is discharged, sometimes containing dissolved oxygen. Sewage voided directly into the sewer.

Q. Under which of these headings would the sewage from Manhattan Island, from the Greater City of New York, come?

A. Fresh sewage.

Q. And under which of these headings would the sewage contemplated to be discharged through the Passaic Valley trunk outfall come?

A. Putrid or septic sewage.

Q. Now, as to their drains on oxygen, is the union between septic sewage and oxygen rapid and chemical or otherwise?

A. The gases produced by the decomposition of septic sewage in-

terfere with the growth of bacteria which, feeding upon the oxygen and the organic matter in the sewage, bring about its purification. Therefore, the septic sewage does not so readily become purified, through the agency of oxygen as does fresh sewage.

Q. And the agency for the purification of fresh sewage
2894 through the chemical item oxygen is what, bacterial or chemical?

A. Bacterial.

Q. Is there any distinction in your mind between the discharge of fresh sewage from a large number of sewers as you have described in Greater New York and the discharge of septic sewage from a trunk sewer?

A. Yes, sir, a very marked distinction. The fresh sewage would be discharged from numerous sewers in such a way that it could mix more readily with the water of the harbor, flowing, as a rule, at right angles with it, while the septic sewage is discharged in such a way that it rises to the surface in the form of a field, after which it is blown about by the wind or carried about by the tide until it becomes mingled with the waters of the harbor, the process requiring several hours.

Q. Is the demand on the oxygen a rapid one as compared with the demand made by fresh sewage. In other words, does it regulate and rapidly exhaust the oxygen content of the water into which septic sewage is discharged?

A. Immediately after the odoriferous gases dissipate into the air the septic sewage takes up the oxygen of the water very rapidly.

Q. You were asked about an effluent free from visible suspended particles. May an effluent be free from visible suspended particles and yet rich in colloidal matters that are putrescrible and coagulable and subject to deposits?

A. Certainly; an example of that is furnished by urine, which is free from visible suspended matter.

Recross-examination by Mr. Riker:

Q. Mr. Weston, you say that in your opinion these specific appliances and processes described in the stipulation will not produce the effluent described in that stipulation?

A. Yes, sir.

Q. That is your opinion?

A. That is my opinion.

Q. In your opinion is it feasible to produce such an effluent by the adoption of other appliances, devices and processes?

A. In part, yes; in part no.

Q. In what part no?

2895 A. There might be a few visible suspended particles from a sewage disposal plant without danger providing the effluent was non-putrescible, without causing any objectionable deposit, that is, objectionable in my opinion, or any putrefactive changes in the waters, or any disagreeable odors, or producing any film of grease on the surface of the harbor, or causing any injury to public health, or any nuisane.

Q. There might be such an effluent?
A. Yes.
Q. What part of the effluent as described there is not feasible to produce?
A. An effluent entirely free from visible suspended particles.
Q. Is that the only respect in which it is not feasible to produce the effluent described in the stipulation?
A. Yes.
Q. Well now, it being in your opinion impossible to produce by the appliances, devices and processes described in the stipulation, do you think that through additional arrangements it might be produced?
A. It might be produced by suitable arrangements.
Mr. Riker: That is all.

SERENO S. PRATT a witness called on behalf of Complainants, being first duly sworn, testified as follows:

Direct examination by Mr. O'Sullivan:

Q. Are you a resident of this City?
A. Yes, sir.
Q. Are you connected with any of our civic bodies, Mr. Pratt?
A. I am Secretary of the Chamber of Commerce of the State of New York.
Q. What are the objects of the New York Chamber of Commerce?
A. Well, if I should quote from the objects of the Chamber, as stated in its original charter granted in 1768, those objects are to encourage and promote by just and lawful ways and means such measures as will tend to promote and extend just and lawful commerce, the charter stating that inestimable benefits have accrued to mankind from commerce. The scope of its activities will be shown by the titles of its standing committees, if you would like them.
2896 Q. Just name some of them?
A. A Committee on Finance and Currency; a Committee on Foreign Commerce and Revenue Laws; a Committee on Internal trade and Improvements; a Committee on the Harbor and Shipping; a Committee on Insurance; a committee on State and Municipal Taxation; a Committee on Arbitration, and there is an Executive Committee.
Q. Taking the Committee on Harbor and Shipping, for instance, the scope of their functions?
A. That Committee through a great many years has been looking after the interests of the port of New York, especially its harbor and its protection against obstructions, the deepening of its channels to the sea, and the extension of its terminal facilities.
Q. Do they consider these in the interests of the commerce of the port?
A. Certainly, sir.

Q. Does the Chamber of Commerce collect any statistics relating to foreign and domestic commerce?

A. The Chamber issues an annual report, of which the Secretary is editor, and a large part of that report consists in statistics relating to commerce and trade of the cities and of the port.

Q. How are these statistics compiled by you as Secretary?

A. They are obtained from official sources, such as the Bureau of Statistics, the Department of Commerce and Labor at Washington, and the Census Bureau and the various departments of the State and the City.

Q. Now, as to your receiving those statistics from the Federal Bureau?

A. I try to analyze them with a view to ascertaining what would be the standing of the port, especially as compared with other cities.

Q. What is the standing of the port of New York now as compared with the other great cities of the country?

A. It is easily first both in finance and in foreign commerce and internal trade.

Q. How as to domestic commerce and banking?

A. The New York Commerce Commission reported in 1899 that the Domestic water borne commerce of New York was valued at seven billions of dollars and was increasing at the rate of five per cent. a year. At that rate it should amount now to considerably over eleven billions of dollars. This relates to the domestic water borne commerce alone. I should say that the best available
2897 method of eliciting the total business of New York was by means of its bank clearings. It is stated by competent statisticians that 85 per cent. of the business of this country is done by means of checks so that the volume of the exchange of checks would show at least 85 per cent. of the total business of any community. The last calendar year the total bank clearings of the United States aggregated over 158 billions of dollars, of which more than 92 billions was in the City of New York, or near 60 per cent.

Q. Of the whole?

A. Of the whole; yes, sir.

Q. Now, taking these figures as a basis, what did you estimate the business of the country carried on in the port of New York to be about?

Mr. Riker: One moment. I think this has gone far enough without objection. The question is objected to as irrelevant and immaterial, though no doubt interesting.

The Commissioner: Note the objection of counsel for defendants.

A. I should say that on the basis of those clearings it would be about 92 billions of dollars a year. That is represented by checks. In addition there is the cash business.

Q. What is the foreign commerce of the port of New York, and what proportion of the foreign commerce of the United States is carried on in the port of New York?

Mr. Riker: The same objection.

The Commissioner: Note the objection of Counsel for Defendants.

Mr. O'Sullivan: In answer to that objection, I would like it to appear on the record that this matter is being elicited in accordance with allegations that appear in the Bill of Complaint. It is one of the formal allegations, on which issue has been joined, and which defendants in their answer have put upon us to prove.

Mr. Riker: The record will show.

A. The total foreign commerce of the United States during the fiscal year ending June 30th, 1911, was $3,783,350,177.
2898 The total foreign commerce of the port of New York in the same fiscal year was $1,744,877,134. Therefore New York's share of the total foreign commerce of the United States was 46.12 per cent.

Q. What is New York's share of the total imports of the country in the fiscal year ending June 30th, 1911?

Mr. Riker: The same objection.

The Commissioner: Note the objection of Counsel for Defendants.

A. 55.71 per cent.

Q. And what was New York's share, the share of the port of New York of the exports of the country during the same period?

A. 38.52 per cent.

Q. How does the port of New York as a port of entry compare with the other great seaport towns in the world?

Mr. Riker: The same objection.

The Commissioner: Note the objection of Counsel for Defendants.

A. The report printed by the Chamber in 1910, by its Committee on Finance and currency, quote- the Commissioner of Corporations of the United States in his report on transportation by water, that New York is by far the most important center of water borne commerce in the United States. The same report of our Chamber's Committee quotes the Chicago Harbor Commission of 1909, saying that the value of goods in foreign commerce in New York at that time was 1,311,000,000 compared with 1,220,000,000 in London, which is the largest city of the world. It declared that New York's foreign commerce was larger than that of either London, Liverpool or Hamburg. A comparison based upon statistics given by the United States authorities shows that New York in number of net registered tons of shipping entered in the foreign trade is the greatest port of the world, being, however, very closely followed by Antwerp, Hamburg and London.

Q. Have you got any figures to show the shipping arrivals in 1911?

A. There were, 9,719.

Q. At the port of New York?

A. Yes, sir.

2899 Q. Now, what status has the City of New York itself as a manufacturing center?

Mr. Riker: The same objection.

The Commissioner: Note the objection of Counsel for Defendants.

A. The statistics of the Bureau of Censuses recently issued shows that it is the largest manufacturing center in the United States. The City has about five per cent. of the population of the country, but it contains nearly 10 per cent. of the industrial establishments of the country, and the value of its manufacturing product is nearly 10 per cent.

Q. Of what?

A. Of the total manufacturing products of the United States.

Q. Of the whole nation?

A. Yes, sir, of the whole nation. The City contains 25,938 industrial establishments. That is, the City of New York, and that number is greater than the aggregate industrial establishments in the four cities of Chicago, Philadelphia, St. Louis and Cleveland combined. The value of the manufacturing products amount to $2,029,693,000, which is larger than that of Chicago and Philadelphia combined.

Q. Have you any figures showing the estimated number of wage earners employed in these industrial centers in New York City?

Mr. Riker: The same objection.

The Commissioner: Note the objection of Counsel for Defendants.

A. 554,000 wage earners are employed in manufacturing pursuits in this city. Greater than that of Chicago and Philadelphia combined.

Q. I will ask you to extend that a little. Do the number of wage earners that you have just given comprise the number that are actually dependent upon these manufacturing interests?

Mr. Riker: The same objection.

The Commissioner: Note the objection of Counsel for Defendants.

A. It is usual to believe from statisticians, to estimate that there is a family of five to every wage earner. On the basis of such

2900 an estimate it would be fair to say that about two millions and a half and over in the City of New York depend on manufacturing pursuits for their livelihood.

Q. Do you know anything about the passenger carrying accommodations and the number that are received daily at our ports?

Mr. Riker: The same objection.

The Commissioner: Note the objection of Counsel for Defendants.

A. You mean from foreign countries?

Q. Yes.

A. I can find it here from statistics furnished by the Commissioner of Immigration. There were 556,333 immigrants arriving

at the port of New York in 1911, and in the same year there were 180,261 alien cabin passengers arriving.

Cross-examination by Mr. Riker:

Q. Do you happen to know whether Ellis Island is within the limits of the State of New Jersey or the State of New York?
A. I do not.
Q. That is the point of arrival of the immigrants?
A. Yes, sir; I am speaking of the port of New York.
Q. I am asking you a question, Mr. Pratt, will you answer it?
A. I have already answered it.
Q. Very well, will you answer it again?
A. Very well, I said I do not know.
Q. You know that they arrive at Ellis Island do you not?
A. Yes, sir.

Mr. Riker: That is all.

Cross-examination by Mr. McCarter:

Q. By the port of New York of course you include Hoboken and Jersey City?
A. Yes, sir; the port of New York includes that.
Q. Is it a fact, Mr. Pratt, that the proportion of the excess that you have described in New York over other cities is decreasing, and that Baltimore, Philadelphia, Boston and other ports are increasing at the expense of New York?
A. In some respects they are.
Q. In what respects are they?
2901 A. Largely in bulk cargoes and among the tramp steamers. Our great force is in regular trade.
Q. Has not that been true to such an extent as to rather alarm the Chamber of Commerce and cause them to investigate the subject?
A. Yes.
Q. Long before the Passaic Valley Sewerage Commission was ever dreamt of?
A. Yes.
Q. Is there a Committee on that very subject, or does the Committee on Foreign Commerce take up that particular topic?
A. The Committee on Harbor and shipping have done so; yes, sir.

Mr. McCarter: I think that is all.
Mr. O'Sullivan: That is all, Mr. Pratt, very much obliged to you.

WILLIAM P. MASON, a witness called on behalf of Complainants, being first duly sworn, testified as follows:

Direct examination by Mr. O'Sullivan:

Q. Mr. Mason, where do you reside?
A. Troy, New York.
Q. Where did you pursue your studies?

A. I am a graduate of Rensselaer Polytechnic Institute; Union University; took a special course of study as a post graduate at Harvard and subsequently at the Pasteur Institute at Paris.

Q. Do you hold any teaching position in any of our large institutions?

A. I am Professor of Chemistry at the Renssalaer Polytechnic Institute at Troy.

Q. You are head of that department?

A. Head of that department.

Q. How long have you been so connected with the Rensselaer Polytechnic Institute?

A. I am not head of the Polytechnic Institute.

Q. How long have you been connected with the Institute?

A. I have been on the faculty of the Polytechnic Institute for over 25 years.

Q. Have you had any facilities or opportunities for practice on questions dealing with water and water supply and sewage disposal?

2902 A. I have; that is my business.

Q. State if you have contributed anything to the literature of your profession on those subjects?

A. I have written on the subject of water supply, and I am the author of two books and a good many contributions to periodicals.

Q. What are the names of those books?

A. Water supply, and the examination of water published by Wiley & Son.

Q. To what scientific periodicals have you contributed articles.

A. I have contributed articles both domestic and foreign, to a great many. So large a number that I could not give you the titles or names without consulting my notes.

Q. Do you hold membership in any of our scientific bodies?

A. Yes, I am a member of a number of scientific bodies. For instance I am a member of the American Society of Civil Engineers; the American Chemical Society; the American Institute of Chemical Engineers; the American Water Works Association; the New England Water Works Association; the Royal Sanitary Institute of Great Britain. I am a member of the Municipal Hygienists at Paris, the Franklin Institute; the Washington Academy of Sciences; and some others I do not remember.

Q. Are you connected with the Royal Sanitary Institute of London?

A. Yes, sir.

Q. Do you belong to any of the philosophical societies?

A. I belong to the American Philosophical Society.

Q. Did you ever hold any official position in the American Water Works Association?

A. I have been president of that Association in the year 1909 or 1910, I forget which.

Q. Have you membership in the Municipal Engineers of Paris.

A. I am a member of a French Society of approximately that name, but it has a tremendously long name, and to tell the honest truth I do not remember its name.

Q. Do you hold any position in any hygienic or other
2903 body that is now in Congress or about to be?

A. I am President of the Hygienic Session of the International Congress of Applied Chemistry, now in session in New York and Washington.

Q. Have you been employed by cities on questions of municipal water supply?

A. I have on a great many.

Q. Name some of them?

A. Washington, New York, Philadelphia, Columbus, South Carolina, Georgia, South Carolina, Meridian, Mississippi, Birmingham, Alabama, Denver, Colorado, Indianapolis, Indiana, Youngstown, Ohio, Frederickton, New Brunswick, Hawthorne, Maine, Syracuse, New York, Albany, New York, Troy, New York, Bathe, Maine, Oswego, New York, Elmira, New York, Amsterdam, New York, Buffalo, New York, Balston, New York.

Q. Any in Pennsylvania?

A. Yes. Philadelphia, Erie, Pennsylvania, Scranton, Pennsylvania, Jersey City, New Jersey, Newark, New Jersey, Atlantic City, New Jersey, Danville, Virginia, Alexandria, Virginia, Des Moines, Iowa, Duluth, West Superior, Chicago.

Q. Any in Wisconsin?

A. West Superior is in Wisconsin.

Q. And in New Brunswick?

A. I have given one in New Brunswick, Frederickton.

Q. Any in Mississippi?

A. I have given one, Meridian, and there are others, but I do not recall them now. Waterford, New York, Cohoes, New York and others.

Q. In line with your professional duties have you devoted special attention to water supplies and sewage disposal schemes for cities and towns?

A. I have.

Q. Have you made any special study of the harbor waters of New York and the tributaries to these waters?

A. I have, within the past year. I have been familiar with them since boyhood, as I was born here.

Q. Have you made any special trips to familiarize yourself with the conditions of today in New York Harbor waters?

A. Yes, I have in small boats, going completely around the island.

Q. Taking in what rivers?

2904 A. Taking in the East River as far as Fort Hamilton; taking in the entire length of the Harlem, the Hudson, as far as the Island of Manhattan extends, and the Upper Bay, part of the Lower Bay, Newark Bay and the Passaic River above Newark.

Q. Have you examined the Kill van Kull?

A. The Kill van Kull, yes.

Q. Now did you note the physical appearance of the several bodies of water that you described as having made trips on?

A. I noticed them all. I was particular about the physical appearance in all of those waters of which I have made mention.

Q. State what you found?

A. I found that the East River water was heavily polluted, especially along the wharf lines I found that the water down Buttermilk Channel, between Governor's Island and Brooklyn was heavily polluted. I sailed in practically a stream of sewage all out through that section, noting that the prow of the boat turned up waves of grease along through Buttermilk Channel and slightly below that and I found that the pollution extended to down as far as Fort Hamilton. I was particularly interested in noting that the water was polluted off the bathing beaches off South Brooklyn, and polluted in the vicinity of the floating bath houses. I noticed the pollution along the Manhattan shore of the Hudson River. I have noticed some pollution on the Jersey shore, but I did not go over on that side in these trips. I went as far as beyond Newark in the Passaic River, finding that grossly polluted. The upper end of Newark Bay I found grossly polluted. There was a dicided improvement in the lower portion of Newark Bay.

I incidently observed them taking oysters from the oyster grounds on the south shore of Staten Island, and I noticed the character of the dredging going on. There was a large dipper dredge taking up material from the bottom of the Bay south of Governor's Island.

Q. Did you note the character of that deposit that was being removed by dredging?

A. That material was all black evidently being colored black by sulphide of iron.

Q. What was its character?

A. Black mud.

2905 Q. What would that mean as far as pollution is concerned?

A. It is evidence of the formation of sulphide of iron through the action of sulphuretted hydrogen, acting upon the salts of iron present.

Q. Is that hydrogen sulphide ærobic or anærobic in its action?

A. Anærobic.

Mr. McCarter: Just what is the distinction between those, ærobic and anærobic?

Q. What is meant when a bacteriologist employs the terms ærobic and anærobic in bacteriological disintegration?

A. Aerobic changes take place in the presence of oxygen. Anærobic changes take place in the absence of oxygen.

Q. How do they compare, the functional activities of the two types of bacteria that cause these different forms of fermentative change as to offensive odors?

A. The offensive odor comes from the anærobic decomposition. In order to avoid offensive odors, efforts should be made to cause sewage to become distintegrated into its ultimate parts under ærobic conditions.

Q. When the oxygen content is sufficient, or is not materially depleted, which form of this bacterial action do you get?

A. Aerobic.

Q. When the oxygen content is well nigh exhausted or completely so, which form of these batcerial activities do you get?

A. Anærobic.

Q. The witness who preceded you described odoriferous gases among which he named sulphuretted hydrogen,—which form of bacteria is that the product of, the functional activity of?

A. Anærobic bacteria.

Mr. O'Sullivan: Aerobic is from two Greek stems, meaning air and life. The Greek privative "an" in anærobic means without. These terms were first used by Pasteur to indicate the difference in micro-organisms, the ærobic that need air for their functional activity, and the anærobic, those that could be active without air or oxygen.

Adjourned to 2 P. M.

2906

CORPORATION COUNSEL'S OFFICE,
September 4th, 1912—2 p. m.

WILLIAM P. MASON a witness called on behalf of Complainants, recalled for further examination, testified as follows:

Direct examination by Mr. O'Sullivan (resumed):

Q. Professor Mason, have you studied the chemical and bacteriological work of the Metropolitan Sewage Commission of New York as detailed in Complainants' Exhibits Nos. 31, 94, 95, 96, 97, 98, 99, 100, 101, 102, 103, 104, 105, 106, 107, 132, 133, 134, 150, 151, 152, 153, 154, 155, 156?

A. Yes.

Q. Have you studied the results of the analyses of New York Harbor waters as testified to by the experts who have preceded you in this present suit?

A. I have.

Q. Will you state the conditions in which you found the waters of the rivers and bays observed by you during the tour of inspection, which you testified you made in these boats?

A. I found the water of the Harlem River grossly polluted at every point; that of the East River practically as bad; the waters of the Hudson River and the Upper Bay were less objectionable but yet showed serious pollution in many places particularly along the shores. The water of Buttermilk channel was especially bad and the boat I was in sailed in what was distinctly badly polluted water down as far as the Narrows. The water off the South Brooklyn bathing beach was too polluted for bathing purposes, and certain floating bath houses were located at points where the water was unfit to bathe in. The water of the Passaic River I found exceedingly foul; that of the upper Newark Bay also foul, but in the lower portion of said Newark Bay the water was materially improved and presented in general a better appearance than that of New York Bay into which it emptied.

Q. In what condition did you find the waters of New York Upper Bay?

A. I found the water of New York Upper Bay polluted heavily.

2907 Q. Have you given observation and study to the methods employed by other cities in disposing of sewage by allowing the same to flow into large bodies of water with a view to its becoming distributed and digested?

A. I have. I have examined such distribution at Boston, Salem, Beverly, Santa Monica, California and Washington.

Q. Have you given consideration to the proposed project of the Passaic Valley Sewerage Commissioners whereby the combined sewage of certain New Jersey cities and towns is to be emptied into New York Bay at or near a point known as Robbins Reef?

A. I have.

Q. Have you given study to the methods employed for the discharge of sewage in Boston Harbor?

A. I have.

Q. Will you state what difference in results, if any, would follow from the discharge of sewage as proposed by the Passaic Valley trunk sewer project at Robbins Reef and the discharge of sewage as now effected from the outfalls in Boston Harbor?

A. The difference would be material for the reason that the Boston sewage is emptied into a bay with a broad free opening to the sea, while sewage emptied at Robbins Reef would have materially less opportunity to reach the sea because of the nearly landlocked condition of the upper New York bay, which in its turn empties into the partially closed lower bay intervening between it and the ocean. Moreover, the area of Upper New York Bay is much smaller than Boston Bay, as is readily seen by consulting the Government maps of the two bays, which I have here, drawn to the same scale.

Q. Where did you get this map Professor which you produce, and which you have described as a map of Boston Bay?

A. I got that by ordering it through a stationer.

Q. From where?

A. I ordered it from him. I just simply ordered the government map of the two harbors. I do not know where he got it. It is an official map issued by the Coast and Geodetic Survey. I presume he sent to Washington for it.

2908 Mr. O'Sullivan: I offer in evidence the map produced by this witness of Boston Harbor, entitled United States East Coast of Massachusetts, Boston Harbor, initial C. & G. S. issued by the Coast & Geodetic Survey of the United States, and ask that it be marked Complainants' Exhibit No. 170.

The Commissioner: Received and marked Complainants' Exhibit No. 170.

Marked Complainants' Exhibit No. 170.

Mr. O'Sullivan: I offer in evidence Government map produced by this witness entitled New York Bay and Harbor Polyconic projection, published at Washington, D. C., February 1910, by the Coast & Geodetic Survey. I offer it in evidence and ask that it be marked Complainants' Exhibit No. 171, and in connection with that

I offer map also produced by this witness entitled New York Bay & Harbor, Lower Half, initialed C. & G. S., issued by the United States Geodetic and Coast Survey, and ask that it be marked Complainants' Exhibit No. 171A.

The Commissioner: Received and marked Complainants' Exhibits Nos. 171 and 171A respectively.

Marked Complainants' Exhibit Nos. 171 and 171A, respectively.

Q. Professor Mason will you state the results of your observations on the sewage disposal of Beverly, Salem, Washington, and Santa Monica and compare these schemes of sewage disposal with what in your experience might be expected to follow from the discharge of the Passaic Valley trunk sewer outfall at Robbins Reef?

Mr. Riker: The question is objected to on the ground that it has not yet been made to appear what the witness understands will be the character of the outfall at Robbins Reef as proposed by the Passaic Valley Sewerage Commissioners.

The Commissioner: Note the objection of Counsel for defendants.

A. At Beverly and at Salem the conditions are quite similar to those at Boston. The sewage is emptied into a bay with open communication with the ocean. At Santa Monica the sewage is carried to an outfall some distance out in the ocean itself while at Washington the sewage is added to the Potomac River at a point
2000 where the up tide cannot carry it against the current of the river back to the city. At none of these places is there such opportunity for the sewage to flow back and forth with the tide before going to sea in the manner that would be the case with sewage deposited at Robbins Reef.

Q. How does the water of Boston Harbor in the vicinity of Boston compare with the present appearance of the water in New York Upper Bay?

A. The appearance is much better than is the case in New York Upper Bay; very much cleaner.

Q. State whether or not you have examined the float experiments made by the Metropolitan Sewerage Commission now in evidence in this case, and if so, state with what results?

Mr. Riker: One moment, Professor, I object to the question because it is not specific and a hypothetical question should be presented to this witness embodying the effect of the testimony, the legal effect of the testimony, in order that it may appear just upon what facts the witness is testifying, and whether or not they are established by the evidence.

The Commissioner: Note the objection of Counsel for Defendants.

A. I have examined them, and they show that the water of the Upper New York Bay flows back and forth with the tides a number of times before finally reaching the ocean.

Q. Would the oscillations of the waters of the Bay, to which you

have just testified, interfere with the sewage discharged from Robbins Reef readily reaching the ocean?

A. It certainly would.

Q. You testified that you found the waters of the Passaic River and the Upper Newark Bay foul in character, and that in the lower portion of Newark Bay, the water was materially improved, and presented in general a better appearance than that of New York Upper Bay into which it empties. To what cause do you attribute these conditions?

Mr. Riker: The question is objected to as calling for an answer that is immaterial and irrelevant to the issue.

2910 The Commissioner: Note the objection of Counsel for Defendants.

A. I attribute the improvement of the waters of lower Newark Bay to the self-purification of such waters by natural processes such as sedimentation and the purification influences, both chemical and biological, which accompany the lapse of time.

Q. Will you state why you regard the water in the lower reaches of Newark Bay as better in appearance than the water in Upper New York Bay?

Mr. Riker: The same objection.

The Commissioner: Note the objection of Counsel for Defendants.

A. I consider the water of lower Newark Bay superior to that of Upper New York Bay, first because I have observed it to have a better physical appearance; second, because I find from the records of analytical results secured by the Metropolitan Sewerage Commission it contains a greater amount of dissolved oxygen, and third, because it contains fewer bacteria per cubic centimeter.

Q. Under existing conditions such as you have described, what influence has the inflow of the water from Newark Bay on Upper New York Bay?

Mr. Riker: The same objection.

The Commissioner: Note the objection of Counsel for Defendants.

A. I consider the water of New York Bay is improved by the flow from Newark Bay under present conditions.

Q. Are the natural purifying agencies of Newark Bay sufficient to dispose of the polluting material which enters that bay from the Passaic River?

Mr. Riker: The same objection.

The Commissioner: Note the objection of Counsel for Defendants.

A. No; not in my opinion; but in my opinion such polluting material is so reduced in quantity, through the action of the said purifying agencies, as to render the water of lower Newark Bay better in quality than the water of New York Bay into which it flows.

Q. Would the present existing conditions, which you have testi-

fied to, be altered, if the proposed plans of the Passaic Valley
2911 Sewerage Commissioners were put into operation, and the sewage carried by tunnel to Robbins Reef outfall and discharged there?

Mr. Riker: The question is objected to on the same ground and also because it does not appear to what conditions the witness' attention is drawn.

The Commissioner: Note the objection of Counsel for Defendants.

A. Yes, for the reason that under the present conditions such New Jersey sewage as reaches New York bay arrives there diluted by the water of Newark Bay and partially disposed of by the purification processes taking place in that bay; whereas, if the proposed sewage tunnel plan were in operation, straight sewage would enter New York Bay from the outfall at Robbins Reef. Under present conditions New Jersey is sending into New York bay a diluted and partially purified effluent, which is better than the water of New York Bay itself, with the result that New York Bay water is improved rather than damaged by such inflow, while if straight sewage were directly emptied into New York Bay through the proposed tunnel the water of said bay would be correspondingly damaged thereby.

Q. What scientific reasons do you give why a raw sewage such as is proposed to be discharged from the Passaic Valley trunk sewer at Robbins Reef should not be discharged at Robbins Reef as proposed by the Passaic Valley Sewerage Commissioners?

A. In my opinion it should not, because the Bay of New York is already seriously polluted, and will in the near future become much more so if some means be not taken to protect it against the growing volume of waste material produced by a rapidly increasing population. In my opinion the operation of the extensive plant proposed by the Passaic Valley Sewerage Commission will surely tend to damage rather than to improve the condition of the water of New York Bay, and will lay an added burden upon the already heavily loaded purification powers of the bay water. It will be a step towards hastening the day when an acknowledged nuisance will be established throughout the length and breadth of the bay.
2912 It is not possible to accurately state just when a nuisance would begin nor how much sewage would be necessary to create it. No hard and fast rule can be laid down and made to serve for general application, for the reason that each case must be judged upon its own merits; but in the present instance the volume of polluting material is so vast, and its great increase is so certain, that common caution demands that no addition shall be made to it that can possibly be avoided.

Q. Basing your answer upon your professional observations and experience, can you state whether or not standards of public decency in sewage disposal are fixed or are changing?

A. I believe they are changing. I believe there will be such a change and that the public of the future will set higher standards

whereby to judge of the fitness of things than is demanded today. Such is my opinion because I have observed the higher standards demanded of late for good water, efficient sewage disposal, proper food, suitable ventilation and improved hygienic surroundings. In my opinion there will be in the near future more marked opposition to the further pollution of New York Bay than there is at present.

Q. Would the proposed sewer outflow at Robbins Reef as contemplated by the Passaic Valley trunk sewer project be injurious to public health?

Mr. Riker: The question is objected to on the ground that it does not appear that this witness understands what the projected outflow is.

The Commissioner: Note the objection of Counsel for Defendants.

A. Not directly, except so far as it increased danger to bathers and eaters of shellfish, but the water of New York Bay is already too polluted for bathing or oyster culture.

Q. To what extent would it be injurious indirectly?

A. Illness can be produced by unpleasant sights and sounds and smells; and sometimes by simply the suggestion of them. Such influences may result in the lowering of the vital "resistance"
2913 whereby invading pathogenic germs, coming from other sources, may secure a firm lodgment in the body and induce disease.

Q. Is sewage pollution of a tidal water more or less objectionable than sewage pollution of a non-tidal water?

A. If there be lack of easy flow to the sea then pollution of a tidal water is more objectionable, for the reason that it permits of sewage material becoming stranded upon the foreshores during low tide.

Q. Do deposits of sewage material take place more readily from sewage discharged into salt or brackish water or into fresh water?

A. Deposit of sewage material would take place more readily if the sewage were discharged into salt water.

Q. What results would arise from sewage solids becoming stranded on exposed foreshores during low tide?

A. Such stranded materials would be unsightly and ill smelling and might become centers of infection through the agency of flies.

Q. You have testified, Professor Mason, to your observation of sewage discharges at Boston and other places. Can you state whether the sewage so discharged was septic or not?

A. It was septic and ill smelling at all of the places I have mentioned except Washington. There it had no odor whatever as it was fresh sewage, about four hours old.

Q. Will screening remove more or less of the solid materials from—more or less of the solid material from fresh sewage than from septic sewage ,and give the reasons for year answer?

A. More solids will be removed by screens from fresh sewage, because the septic process tends to reduce sundry of the suspended solids to liquid or gaseous forms.

Q. Will the sewage discharged or proposed to be discharged at Robbins Reef outfall through the proposed Passaic Valley trunk sewer be fresh or septic?

A. It will be septic.

Q. Have you examined the stipulation entered into between the United States and the State of New Jersey relative to the operation of the proposed trunk sewer system, where certain results are
2914 promised as to the character of the effluent?

A. I have.

Q. Will the method to be employed as described in that stipulation secure the results promised in that instrument, and if not, why not?

A. In my opinion it will not, for these reasons: The first clause says: "There will be absence in New York Bay of visible suspended particles coming from the Passaic Valley Sewage." This will be impossible of strict accomplishment, as fine material such as will pass the 0.4 inch screen cannot be entirely removed by settlement during the time proposed.

Under clause two, it is agreed that no bank of sediment shall form capable of interfering with navigation. No time limit is placed upon this agreement and we must naturally expect that gradual accumulation of sewage deposits will in time occur. Moreover, so far as removal of dissolved oxygen from the water is concerned, the collection of oxidizable material on the bay bottom must surely have its effect as is instanced in the Chicago Drainage Canal.

Under clause three it is agreed that there will be absence of odors due to the Passaic Valley sewage. Of course this result is impossible to secure in the vicinity of the Robbins Reef outlets, as anyone can observe for himself by visiting the disposal system at Boston or Salem. How intense the smell may be or how far it will extend would be a matter for conjecture only. However, inasmuch as the proposed disposal field is near the main ship channel and the route of the ferry boats, the traveling public will probably be carried within the smell area.

Under clause four it is agreed that, at the dispersion area or elsewhere, there shall be a practical absence on the surface of the water of any grease or color due to the sewage discharge. This would seem to be an agreement that the dispersion area would be difficult or impossible of detection by eyesight. No similar discharge up to the present has been so fortunate and in my opinion the one here proposed would prove no exception to the rule.

In clause five it is stated that there will be no injury to the
2915 public health resulting from the proposed discharge and I believe that statement to be correct insofar as it refers to an injury that would be reflected in an increased death rate. How far the discharge would aid in producing conditions that would reduce resistence to disease invasion by offending the senses it would not be possible to say.

The same clause states that no public or private nuisance will be created by the discharge. Taken alone by itself, the discharge would create conditions which from the start might or might not be termed

a nuisance by some people, according to the nature of their aesthetic views; but it certainly would at once begin to contribute its part towards the final establishment of conditions that, in the course of time, would be pronounced a nuisance by all. However, when in course of time the volume of the sewage now flowing from Manhattan and the adjacent cities shall have so increased as to exhaust the purifying power of the bay water, then the proposed Passaic discharge would become a nuisance by itself and not merely a contributory agent.

In clause seven it is agreed that the discharge of the sewage shall not reduce the dissolved oxygen of the bay water to such an extent as to interfere with major fish life. In this stipulation, as in most of the others, there would be practical impossibility of proving that any harm *might that* be done was due to the operation of Passaic Valley sewage rather than to the effect of sewage material from other sources. It would be true, however, that if the dissolved oxygen of the bay water were in fact to become unduly reduced the discharge from the proposed Passaic Valley tunnel would aid in such reduction.

Q. Dr. Mason, you have just testified that the proposed discharge would contribute its part towards the final establishment of conditions that in time will be pronounced a nuisance by all. I ask you to explain what you mean by that expression?

A. I mean that when the rate of pollution exceeds that of purification there will be an intensifying of unsatisfactory conditions until the result becomes unbearable. No better illustration can
2916 be given than the present condition of the Passaic River. When sewage was first turned into that stream the natural processes of purification easily took care of it and the use of the river as a drain was without bad result; but the time has come when such use has been overdone and a nuisance has been created.

Q. Professor Mason you have employed the term "nuisance" in answer to my question. Will you please state what you mean when you employ that term?

A. A nuisance is produced when there is established a condition which seriously offends the senses of the average person. It may, or may not, be accompanied by a "danger" to life or health.

Q. Is it feasible to maintain the waters of the Hudson River and New York Upper Bay in their original state of purity?

A. No. It would be impossible to so protect and maintain them. But I hold that the water ways should be kept relatively as clean as the streets are kept. It is not expected that a street pavement shall be as clean as a house floor, but the accumulation upon the street of unsightly garbage is not permitted, and the same measure of cleanliness should be applied to the bay and river waters.

Q. During the hearings in this case Professor Mason, there has been an attempt to parallel the conditions at the outfall in Boston Harbor and in New York Upper Bay as proposed by the Passaic Valley Trunk Sewer project. Are these conditions similar to any extent?

Mr. Riker: The question is objected to on the ground that it contains a statement by counsel of his understanding of what has been attempted, which is not based upon the evidence in the case.

The Commissioner: Note the objection of Counsel for Defendants.

A. They are not for the reasons I have already testified to. In the case of Boston the quantity of sewage is less, and the body of water into which it is emptied is greater, and the said body of water has a freer opening to the sea. In New York Bay the body of sewage is larger and the Bay of New York is much smaller than the
2917 Boston Bay and the opening to the sea is constricted in comparison with that of Boston Harbor.

Q. How do they compare in area, the sites of the proposed outfall in Robbins Reef in New York Upper Bay and those of the Boston outfall as to the bodies of water into which they discharge?

A. That question would call for a numerical answer which I cannot give. The best I can do is to call your attention to the government maps which I have presented exhibits numbers 170, 171, and 171A, and to call attention to the fact that the Nut Island discharge for instance, which is one of Boston's sewage discharge points, the Nut Island discharge of about 33 million gallons per day is discharged into a body of water known as Quincy Bay, which is about the size of New York Upper Bay, a little larger. That can be seen by comparing the maps directly with the eye.

Q. As to the physical contours, how would you compare the two bodies of water, Boston Harbor and New York Upper Bay?

A. Boston Harbor is larger than New York Upper Bay and is freely open to the sea. New York Upper Bay is really land locked, having its connection with the sea via the Narrows a relatively narrow channel, much narrower than you would get in case of Boston Harbor.

Q. And as to the tidal phenomena, in the two bodies of water; what influence would that have?

A. There would not be as much opportunity for floating backwards and forwards in Boston Harbor, as in the case of New York Harbor, because of its being open, as it is, although of course there is some floating backwards and forwards, no question about that, but the floats which have been set up in New York Harbor show that the water there has been proven to oscillate a number of times before finally getting to the sea.

Q. Do I understand then your description of Boston Harbor as an open arm of the sea and New York Upper Bay as substantially an inland lake?

A. That is what I have already said.

Q. Have you had submitted to you the various exhibits in
2918 this case, Professor Mason?

A. I have.

Q. Have you heard some of the witnesses testify, some of the professional expert witnesses?

A. A number of them.

Q. Professor Mason assuming that the facts and data now have

been proven as set forth in Complainants' Exhibits from Numbers 1 to 158 inclusive; assume that these exhibits from Numbers 1 to 158 inclusive, set forth correctly the observations, statistics, chemical analyses, bacterial determinations, photographic reproductions of places and things observed, charts and maps of contours of surface and subsurface localities, apparatus employed, together with the reports made thereon by the observers, and now in evidence in this case, have been proven. Assume also, that the tabulations of oxygen determinations, the tabulations of bacterial count; the tables of averages for oxygen determinations, bacterial count and harbor deposits; the charts plotting float observations, oxygen percentages, bacterial count, and mud examinations, the current observations, report of tidal actions, and graphic charts thereof, current velocities, indices of sample stations and plottings thereof; microscopic examinations of harbor deposits, photographs and charts of sewage fields, dispersion areas, and sleek fields; all as set forth in Complainant's Exhibits from Numbers 1 to 158, inclusive, and such other scientific data as are included in these exhibits are proven.

Assume, also that the testimony which you have reviewed and which has been given by witnesses preceding you in the hearings in the present suit between the State of New York and the State of New Jersey, on all these enumerated matters, and also on the precipitation; run-off; present and prospective populations of the drainage areas, and such other scientific data as has been included in the testimony given thereon, have proven the matters therein testified to—

Taking all these facts and circumstances of record in this case, and facts observed by you and to which you have testified, into your full consideration, what, in your opinion, will be the results of the contemplated discharge from the Passaic Valley Trunk
2919 Sewer outlet into New York Upper Bay, in the vicinity of Robbins Reef, on the Harbor Waters and tidal waters of New York Harbor, under present existing conditions and under prospective conditions, on or about the year 1940, and during the intervening period between the present year, 1912, and the year 1940?

Mr. Riker: I desire to interpose the same objection to this question as propounded to this witness as I interposed to the same question when it was propounded to the last witness.

The Commissioner: Note the objection of Counsel for Defendants.

A. In my opinion the water of New York Bay will be seriously damaged by the pouring therein of the proposed volume of sewage in the manner proposed, and the reasons that I have already given in my testimony up to the present point.

Q. Damaged to what extent, Professor Mason?

A. That is a hard question to answer. I do not know to what extent it will be damaged. You cannot put that in numbers. You cannot explain that mathematically, but it will be unduly damaged, the bay water will be. Its pollution, which is now great, will be made greater and the time will come when that pollution growing from all sources, will produce a bay wide nuisance. I have already

expressed as well as I can my general opinion of the situation in answer to several of your previous questions.

Mr. O'Sullivan: Your witness, Mr. Riker.

Cross-examination by Mr. Riker:

Q. Professor, in your examination of the waters about New York that you testified to, where did you find the most polluted body of water?

A. I found it very grossly polluted in Gowanus Canal; very grossly polluted along the Brooklyn shore, notably so at DeGraw Street and it was badly polluted along the Long Island shore up towards the Navy Yard and it was very greatly polluted in the Harlem River.

Q. What about the Manhattan shore?

A. It was not so badly polluted along the Manhattan shore, but it was still very badly polluted, nevertheless.

2020 Q. Did you observe the condition of the waters in the slips?

A. I did.

Q. What was the condition?

A. The slips vary a great deal, some of them were grossly polluted, notably near De Graw Street and from DeGraw Street down some distance.

Q. South do you mean towards Governors Island; toward the Brooklyn bridge?

A. From DeGraw Street south toward the south Brooklyn Beach. In several places it was grossly polluted. It was also grossly polluted on the Jersey side near the Pennsylvania Railroad station.

Q. Did you attempt to trace the source of the pollution of the waters that you have just testified to?

A. The source of the pollution—why it was from the sewers.

Q. What sewers?

A. The local sewers.

Q. And where did they discharge, did you observe?

A. Yes, I did. The sewers discharged either at the pier heads or at the slip heads.

Q. And how near the surface at high tide, did you notice that?

A. Some of them I noticed were practically at the surface, and others were submerged. How much I do not know.

Q. And what about the character of the sewage that was being discharged; did you observe that?

A. Yes; it apparently was ordinary municipal sewage.

Q. Not treated in any way?

A. Not treated.

Q. Well, you made some observations in the waters of Newark Bay, I think.

A. Yes.

Q. And the upper part of the Bay you found polluted?

A. Very.

Q. And below the Central Railroad crossing how did you find it?

A. Towards the Union County line, I noticed it was materially better than at the upper end.

Q. Was that difference one that you noted by the eye, or did you determine it in some other way?

A. I made no determinations of a chemical or bacteriological character in connection with this case. I took the determinations as made by other people and my knowledge of the character of the water consequently was the observation of the physical appearance.

2921 Q. And as to any other test you relied upon such data as has been furnished you by others?

A. Yes, notably the Metropolitan Sewerage Commission data.

Q. When you say that the waters of the Lower Newark Bay are better than those of New York Bay, to what waters in New York Bay do you refer?

A. I was referring to the New York Bay as a whole, but I also referred so far as the oxygen content was concerned to the waters in the vicinity of Robbins Reef.

Q. Well, have you the figures which demonstrate that before you?

A. The figures are in the exhibits which are already presented. The figures are in the exhibits numbers 150 to 156 inclusive.

Q. If it be a fact that the average oxygen content at the lower end of Newark Bay is 64 per cent. as against an average oxygen content at Robbins Reef of 72 per cent. which water in your opinion is the more heavily polluted?

A. Lower Newark Bay from that standpoint from those figures.

Q. Do you understand those figures are right?

A. I do not know anything about that. I have never seen it before, but you will find that if you take the average of the oxygen figures for the exhibits which I have referred to, that they read the other way.

Q. Well, I am simply asking you?

A. So far as that is concerned, that reverses what I have said.

Q. And instead of being a beneficial element to the waters of New York Bay at the present time, the waters from Newark Bay are a detriment, is that correct?

A. If that is correct, but you will allow me to make this addition to my statement. There is no statement there as to how the current is going. It may be that the water is coming in from New York Bay and entering Newark Bay. That shows on some of these exhibits that I have just referred to.

Q. If it be the fact that this is the average of all observations at these points at all times in your opinion which is the less polluted water?

A. The less polluted water would be Robbins Reef.

2922 Q. And the waters of Newark Bay then would not be a beneficial element in the waters of New York Bay?

A. Not under those circumstances; not if that is the average of everything.

Q. And the discharge of the waters of Newark Bay and the Pas-

saic River into the Upper New York Bay through the Kill van Kull, if it is entirely free from pollution, would be beneficial, would it not

A. If Newark Bay were free from pollution?

Q. Yes.

A. Surely.

Q. And in the proportion that that discharge is contaminated or polluted resulting in a decrease in the oxygen content and an increase in the bacteriological count, in that degree the discharge becomes more and more injurious?

A. That is true.

Q. And the more of the polluting matter which reaches New York Bay from the New Jersey side, which can be excluded the larger will be the possible pollution by the City of New York with safety; is not that so?

A. Why it is true that if a certain amount of pollution be considered as going into New York Bay, and that amount be constant, if you reduce that which comes from elsewhere than New York, why it permits New York to dump in a larger quantity.

Q. And from that point of view it would be very desirable for the City of New York, and possibly the State of New York to exclude all New Jersey sewage from the waters of New York Bay?

A. By the exclusion of all New Jersey sewage from the waters of New York Bay, it would of course give New York City a longer time before it was obliged to do something to prevent a nuisance.

Q. Now, Professor, what do you understand to be the projected discharge from the Passaic Valley sewer into New York Bay at Robbins Reef, as to the character of the effluent?

A. I understand that the effluent is to be secured by screening the sewage after it reaches a point near Newark Bay and then sedimenting it, and I understand that they anticipate a character of
2923 result which shall be free from suspended material and without odor and so free from material which would produce color and turbidity, and to make the point of discharge practically incapable of being readily determined by the eye, and it shall be an effluent which shall give no nuisance; shall not be detrimental to health and to the satisfaction of the Secretary of War shall not interfere with navigation by causing the accumulation of bottom deposits.

Q. Is that the effluent which in your judgment you have testified will produce a nuisance?

A. That is the ideal effluent which they propose to produce. In my belief they cannot do it.

Q. Do you mean by that that it is not possible to produce an effluent of that character?

A. Oh, it is possible.

Q. How do you reach the conclusion that they will not produce it?

A. Well, in the first place, the sewage as it would leave the tunnel at Robbins Reef could not be perfectly limpid and clear without any material in suspension. Their means for producing that result

would not give such a result. It could not be without smell. It is septic sewage. The smell would stick to it, if it were filtered through filter paper and made a good deal more liquid than it will be by simple sedimentation and screening; the liquid smell as well as the solid. So far as the appearance of it at the point of discharge is concerned, that is the ability to detect that sewage upon the dispersion area, I do not believe that that will be possible by following the proposed plan to make that dispersion invisible.

Q. Why do you state that they will not do it by following their proposed plan. What is the proposed plan, in other words, that you have in mind?

A. The proposed plan that I have in mind I obtained from reading their proposition, namely, the screening of the sewage and the sedimenting of it in sedimentation tanks, for a period something like an hour and a half, and then pumping it into the tunnel.

Q. Those things you understand are stipulated to be put into this system?

A. Yes.

Q. And do you understand that that limits the devices
2924 and appliances and processes which they will use to accomplish the result?

A. I know of no other.

Q. You know of no other device?

A. Which they propose to use.

Q. How do you know what they propose to use?

A. I do not, beyond what they state in plain language.

Q. I read what they state from this exhibit drawing your attention to the second general paragraph, which reads as follows: "The Passaic Valley Sewerage Commissioners further agree with the United States that in the operation of said sewer system at all times the following results will be secured, either through compliance with the requirements of the immediately preceding paragraphs or through requisite lawful additional arrangements." Why do you say that you have no knowledge of anything additional, if you read this stipulation?

A. I read that stipulation and I naturally inferred that they had described what they were going to do.

Q. Why did you infer that from the language that I have read. That is, that that is all that they were going to do, which had been prescribed preceding the second general paragraph?

A. Unquestionably if what they mean by that language is that they propose to add some exhaustive method of sewage disposal not mentioned, why under those circumstances, it would be possible to get a vastly improved effluent.

Q. Is it not your understanding of their proposal that they do propose to get the effluent that is described here. I wish you would look at the stipulation and see if you do not understand the stipulation to be that they will produce the effluent as described in their guarantee to the United States Government?

A. There is no question but what they could get a most excellent effluent if they saw fit to put in the additional material of high grade

to produce the same, as you would find at Saratoga where they drink the effluent.

Q. So there is no question about the feasibility and possibility of producing this effluent; your only doubt being as to their real intention to do it, is that it?

2925 A. Why the Jersey sewage can be purified of course. No doubt about that.

Q. And the effluent as it is described there is what you have already termed the ideal effluent, is it not?

A. It is possible to produce an effluent of that kind, if they see fit to put in the expensive plants, because it might take more than one.

Q. And it is the ideal effluent as you have already called it, is it not?

A. It would be an ideal effluent.

Mr. Riker: That is all.

Redirect examination by Mr. O'Sullivan:

Q. Professor Mason, will the methods described in this stipulation in evidence in this case as Complainants' Exhibit No. 135 produce the effluent guaranteed in that stipulation?

A. No.

Q. Mr. Riker has called your attention to a clause in this stipulation relative to the means prescribed for the production of the effluent, and particularly to that part of the clause "or through requisite lawful additional arrangements." Are you familiar with the debt limit of the municipalities that have entered into the contract with a view to furthering the project of the Passaic Valley Sewerage Commission.

Mr. Riker: I object to it as irrelevant and immaterial.

The Commissioner: Note the objection of Counsel for Defendants.

A. I have no knowledge of it.

Q. Do you know whether it would be lawful for them to enter into any further schemes for purification that would entail very great expense?

A. I do not know.

Q. Are you in a position to state whether or not the means to produce it, in addition to those described would be lawful additional arrangements?

Mr. Riker: I object to the question. This witness is not an expert in the law.

The Commissioner: Note the objection of Counsel for Defendants.

A. I have no knowledge of it.

Q. Would the expense be practically prohibitive for the production of such a large volume of sewage with the effluent such

2926 as is described in the stipulation?

Mr. Riker: I object to it for the same reason.

The Commissioner: Note the objection of Counsel for Defendants.

A. It would be exceedingly expensive.

Q. In answer to Mr. Riker's question relative to New Jersey sewage, did you have in mind the inland sewage that is to be conducted in this trunk sewer or the riparian sewage of the communities in the State of New Jersey that have the right to discharge in New York Upper Bay?

Mr. Riker: The question is objected to on the ground that it calls for a judgment of law as to what communities have the right.

Mr. O'Sullivan: I withdraw the word "right."

(Amended question repeated by the stenographer as follows:)

Q. In answer to Mr. Riker's question relative to New Jersey sewage, did you have in mind the inland sewage that is to be conducted in this trunk sewer or the riparian sewage of the communities of the State of New Jersey that discharge into New York Upper Bay?

A. I had in mind the inland sewage that is to be conducted by the tunnel.

Q. Mr. Riker asked you relative to the oxygen figures and averages upon these for New York Upper Bay. Have you made any such averages yourself?

A. Yes. I took some figures from exhibits 151 and 153, and as they were on both tides, No. 151 showing the dissolved oxygen, and I averaged the dissolved oxygen for Lower Newark Bay and Kill van Kull, and found it to be, the average of 20 samples for Lower Newark Bay and the Kill van Kull, found it to be 78 per cent. saturation; and for the values given in the vicinity of Robbins Reef there were but five samples and they averaged 73 per cent.

Exhibit No. 153 for the total count of bacteria per cubic centimeter, for Lower Newark Bay, there were 46 counts averaging 7600 bacteria per cubic centimeter and for Robbins Reef and vicinity there were 14 counts averaging 10,000 bacteria per cubic centimeter. Those are the only averages I made.

Q. And those averages showed what?

2927 A. Showed the water of Lower Newark Bay to be better than the water of New York Bay in the vicinity of Robbins Reef.

Q. Mr. Riker asked you relative to New York and particularly Manhattan sewage. Is that fresh or otherwise?

A. Fresh.

Q. What do you mean by fresh, Doctor?

A. Sewage that has not yet been acted upon by bacteria, to break the sewage down into simpler bodies.

Q. The sewage contemplated to be discharged at Robbins Reef through the Passic Valley trunk sewer outfall would be in what condition?

A. Septic.

Q. When septic sewage and fresh sewage are discharged into large bodies of water, how are the purifying agencies employed, first, in relation to fresh sewage. Are they chemical or bacteriological?

A. Bacteriological.

Q. And is that a slow or a rapid process?

A. Rather slow.

Q. What would that mean in relation to the consumption of oxygen?

A. Fresh sewage does not consume oxygen as rapidly as septic sewage.

Q. How is the purification of septic sewage effected?

A. Septic sewage is partly broken up by bacterial action and partly directly oxidized.

Q. And is that bacteriological or chemical?

A. Both.

Q. Which exhausts the oxygen content most rapidly, chemical or bacteriological processes?

A. That largely depends upon what is present. In general I can say the septic sewage is quicker in the exhaustion or oxygen than the fresh.

Q. May an effluent look clear, or rather may it look free from suspended visible particles, and still be highly putrescible?

A. It may.

Recross-examination by Mr. Riker:

Q. Professor, you say that the proposed discharge at Robbins Reef from the Passaic Valley sewer will be septic. Have you in mind the effluent described in the stipulation when you say that?

A. I have in mind the effluent which is described, without the additional lawful steps to which reference was made in answer to your previous question. What I am referring to now is in answer to your present question. The effluent I had in mind was the effluent that would be produced by screening, sedimentation and pump-

2928 ing.

Q. And not the ideal effluent described specifically?

A. Not the ideal effluent which is capable of being made, provided they propose to pay for it.

Q. And described in this stipulation?

A. And which is described in that stipulation.

Redirect examination by Mr. O'Sullivan:

Q. And is that effluent feasible in its production under the conditions described in the stipulation?

A. That effluent it is not possible to produce under the stipulation if you omit the final clause, to wit, that they will add to the processes which they have described, some unknown process for further treatment.

Q. And which may be prohibitive in cost?

A. It may be very readily; it probably would be.

Recross-examination by Mr. Riker:

Q. Professor, you have been asked about inland sewage. What is inland sewage?

A. In this particular case I should define inland sewage as non riparian to New York Bay.

Q. Well, how far back do you extend your right?
A. I should call the riparian sewage on the Jersey side at least that coming from Hoboken and Weehawken and Jersey City.
Q. But do not confine yourself to the Jersey side, please. How far do you extend your right?
A. And Manhattan Island and Brooklyn.
Q. On the Brooklyn side how far do you extend your right; how many miles?
A. I do not know how far you have to go back into Brooklyn before you begin to drain toward Jamaica Bay.
Q. What you mean by riparian sewage is that which is within the natural water shed?
A. Yes.
Mr. O'Sullivan: And when sewage is taken from its natural water shed, you consider that it is not riparian?
A. Surely.

Mr. O'Sullivan: That is all.
2929 Mr. Riker: That is all.

Adjourned to September 9th, 1912 at 10:30 A. M.

Supreme Court of the United States, October Term, 1910.

THE PEOPLE OF THE STATE OF NEW YORK, Complainants,
against
THE STATE OF NEW JERSEY and PASSAIC VALLEY SEWERAGE COMMISSIONERS, Defendants.

Before James D. Maher, Esq., Commissioner.

CORPORATION COUNSEL'S OFFICE,
September 9th, 1912—10:30 o'clock a. m.

Appearances:

Dr. William J. O'Sullivan, Special Counsel for the People of the State of New York, Complainants.
Adrian Riker, Esq., of Counsel for the Passaic Valley Sewerage Commissioners, Defendants.
Robert H. McCarter, Esq., Special Counsel for the State of New Jersey, Defendants.
William A. McQuaid, Esq., First Deputy Attorney General of the State of New York, of Counsel for the State of New York.

Met pursuant to adjournment.

2930 ALBERT F. DAWSON, a witness called on behalf of Complainants, being first duly sworn, testified as follows:

Direct examination by Mr. O'Sullivan:

Q. What is your full name?
A. Albert F. Dawson.

Q. What is your business?
A. Public stenographer.
Q. Where is your office?
A. 59 Wall Street.
Q. Mr. Dawson, were you employed on the 9th of December 1908 to report the public hearings given by the New York Harbor Line Board in the Army Building, New York City, in the matter of the application of the Passaic Valley Sewerage Commission for consent of the War Department to the construction and maintenance of a trunk outlet sewer beneath the waters of Newark and New York Bays?
A. I was.
Q. Did you furnish a typewritten copy of the report?
A. I furnished more than that. I furnished two typewritten copies to the Government and two other copies to private individuals; four copies, I think.
Q. Mr. Dawson, I hand you Complainants' Exhibit No. 1 and ask you if that is one of the copies of the report of that hearing furnished by you?
A. It is.

Mr. O'Sullivan: Your witness.
Mr. Riker: No questions.

CALVIN TOMKINS, a witness called on behalf of Complainants, being first duly sworn, testified as follows:

Direct examination by Mr. O'Sullivan:

Q. Commissioner Tomkins, do you hold any official position in this City or in this Municipal Government?
A. The office of Commissioner of Docks.
Q. And where are the offices of the Commissioner of Docks?
A. Pier "A" North River.
Q. Have you collected any statistics relative to the incoming and outgoing tonnage of this port?
A. Yes, we have in the department.
2931 Q. State what the incoming and outgoing tonnage of the port is?

Mr. Riker: The question is objected to as immaterial and irrelevant.
The Commissioner: Note the objection of Counsel for Defendants.
Mr. O'Sullivan: It is one of the allegations in the complaint as to which your answer puts us to the proof.

A. The yearly average of the tonnage that passes in and out of New York Harbor, based on six months' reports, divided into the various sections of the harbor, shows a grand total of 86,642,786 tons.
Q. Now, taking the North River and the Harlem River, how much would that be as their share?
A. In round figures—

Incoming tonnage	23,568,074	
Outgoing tonnage	18,095,044	
Total		41,663,118

Q. What is the total tonnage for the East and Harlem Rivers?

Mr. Riker: The same objection.
The Commissioner: Note the objection of Counsel for Defendants.

A. In round figures—

Incoming tonnage	10,465,584	
Outgoing tonnage	6,385,906	
Total		16,581,490

Q. Now, taking Brooklyn including the East River on the Brooklyn side?

A.—

Incoming tonnage	12,256,250	
Outgoing tonnage	8,985,990	
Total		21,242,240

Q. Now, for the Borough of Queens, have you got the figures?

Mr. Riker: The same objection.
The Commissioner: Note the objection of Counsel for Defendants.

A.—

Incoming tonnage	2,490,608	
Outgoing tonnage	1,851,710	
Total		4,342,318

Q. And for Staten Island?

2932 Mr. Riker: The same objection.
The Commissioner: Note the objection of Counsel for Defendants.

A.—

Incoming tonnage	1,780,640	
Outgoing tonnage	762,980	
Total		2,543,620

That is the foreign and domestic tonnage combined.

Q. In those figures that you have just given, Mr. Tomkins, have you included any of the tonnage figures for the riparian communities along the New Jersey shores?

A. No.

Q. These all deal with the Boroughs of Greater New York?
A. Yes.
Q. Have you got any computations that would show the value of the exports for the year 1910?
A. Yes, based on the figures of the Chamber of Commerce, the exports of the port for 1910 in value were $951,510,979—beg pardon—that is the value of the exports.
Q. And the imports?
A. The value of the imports for the same period was $784,635,-764.
Q. Can you state what the length of the shore line of the City of New York on the Upper Bay is?
A. The length of the shore line of this city on the Upper Bay as measured along the Brooklyn water front from Fort Hamilton to Hamilton Avenue, exclusive of the Gowanus Canal and from Fort Wadsworth to St. George on the Staten Island shore is about 13 miles.
Q. And that is devoted to shipping interests chiefly?
A. A very large part of it is, yes.
Q. Now, taking the 13 miles of water front that you have just described, Commissioner, are there any improvements of the water front?
Mr. Riker: The same objection.
The Commissioner: Note the objection of Counsel for Defendants.
A. Most of the water front is improved. There are some parts of Staten Island, and some sections of the Brooklyn shore that are not improved, but most of it is improved.
Q. Improved by what manner?
A. By the construction of wharves and bulkheads with
2933 expensive terminal facilities, including warehouses and railroad facilities.
Q. It is virtually used for the national commerce of the country as well as the local commerce of New York City?
A. Yes.
Mr. O'Sullivan: Your witness.
Mr. Riker: No questions.
Mr. O'Sullivan: Any questions?
Mr. McCarter: No.

HARRY DE BERKELEY PARSONS a witness called on behalf of Complainants, recalled for further examination, testified as follows:

Direct examination by Mr. O'Sullivan:

Q. Mr. Parsons, you have testified previously in this case?
A. I have.
Q. Did the Metropolitan Sewerage Commission during any portion of its activity devote its special attention to salinometer work?
A. It did.
Q. What is the object of salinometer determinations?
A. The object of the salinometer work was to study the conditions of the tidal waters flowing in and out of the harbor. The Metro-

politan Sewerage Commission, of which the witness is a member made a continuous study of the salinometer records of the waters in the harbor of New York from September 1908 until December 1909 inclusive.

Q. Under whose direction was that work pursued?

A. Under the direction of the commission. The work was carried out in all its detail by instructions gotten up by the commission, and Mr. David S. Merritt, now deceased, was retained by the commission to visit the different stations which were established and collect the records.

Q. Mr. Merritt testified in this case, did he not?

A. He did.

Q. And he died since giving his testimony?

A. He did.

Q. When did the commission plan out the work to be done
2934 with the salinometer, Mr. Parsons?

A. During the year 1908.

Q. And with what object was the work undertaken?

A. To study the conditions of the water in the harbor of New York and to determine the quality of the water with regards to sea water and land water.

Q. Now, as to the salinometer instruments employed, will you describe those instruments?

—. The salinometer was a self contained instrument, which was especially designed for this work. The thermometer scale occupied the center of the instrument and the hydrometer scale was marked in the plan, thus permitting the observer to read with little trouble and with the minimum liability of error both the thermometer and the hydrometer scales. Each salinometer was 30½ centimeters in length and the range of the hydrometer scale was from 1 to 1.03. The length of this scale was about 13 centimeters. The thermometer scale was marked off in degrees Fahrenheit. With each instrument was furnished a case and a glass cylindrical tube for the immersion of the salinometer, and a record book.

Q. Were these instruments specially made for the commission?

A. They were specially made for the commission and each instrument was calibrated and tested and in addition to that the work done by the instruments was checked by chemical analyses.

Q. What do you mean by calibrated, Mr. Parsons? You used that term?

A. By calibrating we mean standardizing; correcting for errors.

Q. How were the stations established for the work to be done through the salinometer determinations?

A. The commission established 11 different stations located as follows: Ambrose Channel Light Vessel, anchored about 9 miles east of Sandy Hook.

West Bank Light Station, located upon the westerly bank of Gedney Channel, near the center of the Lower Bay.

Fort Wadsworth Station, located off the westerly bank of the Narrows.

Robbins Reef Light Station, located in the south-westerly part of the Upper Bay.

2935 Governors Island Light station, located on the westerly side of Governor's Island near Castle William.

Blackwells Island station, located on the westerly side of Blackwells Island, opposite East 53rd Street, Manhattan, part of the year and one part at East 53rd Street for the remaining part of the year.

Throggs Neck station, located at the most southerly part of this point of land.

Fort Washington Point Station, located on the easterly shore of the Hudson River, about opposite West 180 Street, Manhattan.

Tarrytown Light station located on the easterly side of the channel of the Hudson River about one half mile off shore.

Passaic Light station, located in the Upper Part of Newark Bay.

Great Beds Light station, located about 2 miles southeast of Perth Amboy.

At each of the stations there was an observer and salinometer tests were made at regular intervals on each day from September 1908 until December 31st, 1909.

Q. Before you come to that, Mr. Parsons, were these observers trained to use the apparatus, and if so, state what they were trained to use it for, and how?

A. The object of the commission was to obtain a continuous record through a full year. The instruments were given to the observers at the different stations in September 1908, and the work was started at that time so that the months of September, October, November and December 1908 were used as socalled trial months, during which the observers were making continuous records according to the written instructions given to them, and their work was perfected, and their methods made accurate, before the one year's continuous observations started on January 1st, 1909.

Q. Was a complete record of the work kept for the year 1909?

A. A complete record of the work was kept for that year and also for all the other observations that were made in 1908, and the sporadic observations, which were made during 1909, and, for in-

2936 stance, *and for instance,* at various parts of the harbor, other than the stations named, at various depths of water at these different places and a continuous series of observations from Gardeners Bay near Montauk Point on Long Island, through Long Island Sound and the East River, and out in the Atlantic Ocean to a point about 12 miles off Long Branch.

Q. When were the samples of water taken at the different intervals?

A. The waters were sampled during each 24 hours at 8 A. M. 12 o'clock Noon and 4 P. M. and a record was kept of the direction of the currents, the wind and the temperature of the water at the time the sample was taken.

Q. Were the stations visited in rotation and were the records collected from these observers at regular intervals?

A. They were. That duty was performed by Mr. David S. Merritt, and he got from each observer the record in the note book and

those records of observations were corrected to the standard temperature of 60 degrees, Fahrenheit.

Q. What was done then with these records, as to tabulating or other treatment of them?

A. They formed part of the record of the work of the Metropolitan Sewerage Commission.

Q. Were they tabulated?

A. They were.

Q. Now, the term "land water" what was that used to represent?

A. The term "land water" was used to represent in this investigation any water between fresh water and water containing approximately 300 parts of chlorine per one million parts. Between those limits the salinometer observers were to record the reading as containing 100 parts of land water.

Q. What did you take as the standard of sea water?

A. The standard of sea water was a water containing a salinity of 18,000 parts of chlorine per one million parts. Under that condition the salinometer readings would be 1,025 at 60 degrees Fahrenheit.

Q. Now, what were the smallest divisions on the hydrometer of the salinometer?

A. The scale was divided down so that the smallest divisions of the salinometer scale represented a difference of 5 in 4th decimal place. This smallest division on the scale therefore would
2937 represent a difference of 2 per cent. in the amount of land water.

Q. Now, were all these observations corrected to any standard temperature?

A. They were corrected to the standard temperature of 60 degrees Fahrenheit.

Q. Were any other observations made during the year 1909 other than the ones that you have just described, in this harbor work?

A. I think I have described them, all the different parts of the testimony. The work of the commission in brief was first the continuous record at the 11 different stations, and in addition to that observations were made through Long Island Sound from Gardeners Bay to a point about 12 miles off Long Branch in the Atlantic Ocean, and also various observations at points other than the eleven stations named where the salinometer record was taken of the waters at various depths.

Q. In some of this miscellaneous salinometer work were samples taken at considerable depths below the surface?

A. They were.

Q. About how many observations were altogether taken, and recorded in tabular form by the Metropolitan Sewerage Commission?

A. During 1908 and 1909 about 15,500 observations were made, in addition to the miscellaneous observations.

Q. And were all these observations, the 15,500 that you have described, and the miscellaneous observations in addition, were they all corrected to any standard temperature?

A. They were all corrected to 60 degrees Fahrenheit, and a num-

ber of them were also checked by chemical analyses in the laboratory.

Q. I sent you a request, Mr. Parsons, to produce the volume containing the original salinometer work that you have just now described. Have you produced it?

A. I have it in my hand. The tabular record of the salinometer work as done by the Metropolitan Sewerage Commission.

Q. How many pages does that work contain?

A. The pages are not numbered.

Q. Some hundreds?

A. It completely fills a Shipman Common Sense Binder, and forms a volume about 2 1/2 inches in thickness, closely typewritten tabular matter.

2038 Q. What is there in that volume that you now hold in your hand besides the tabulations of those figures?

A. There is nothing in the volume except the tabular record of the observations that were made at these different stations and the averages for each month. That is to say, a general summary. The observations record the date of the month, the hour of the salinometer reading, the temperature, the correction, the specific gravity, the percentage of land water, the wind, the direction of the current and the remarks as regards the direction in which the tide was running at the time.

Q. Were these records, the salinometer record used as a basis for other computations?

A. They were used as a basis of the computations to determine the percentage of sea water and land water in the water of the harbor of New York at different tides, ebb or flood.

Q. Take a single observation, what items are covered by it. That is as to the temperature, the depth, the condition of the wind or other items that surround just that one observation?

A. Opening the record at random, the salinometer record for Fort Wadsworth station, December 1908, shows on the 10th day at 8 A. M. in the morning the salinometer read 1——

Mr. Riker: One moment. I object to this witness testifying from this volume or any of its contents until it is offered, on the ground that it has not been proved or offered in evidence, and if it has any probative value, it should be used in the form of an exhibit.

Mr. O'Sullivan: Counsel for Complainants is now endeavoring to show that from the exceeding volume of this comprehensive record, it would be inadvisable to offer it in evidence on account of its bulk, and the large amount of detailed items, and that question put to this witness is merely to illustrate what number of facts surround a given determination.

The Commissioner: Note the objection of Counsel for Defendants.

Mr. O'Sullivan: These determinations going into many thousands.

Q. You may proceed?

The record shows for December 10th at 8 A. M. in the morning, at the station mentioned before that the salinometer reading was

1.0202, which is recorded in the record for simplicity as 20.2,
2939 the water having a temperature of 39 degrees Fahrenheit. That the correction was 1.1. That the specific gravity was 19.1. That the percentage of land water was 23.6. That the wind was northerly. That the current was northerly. That the tide was flood. That the observations were 6. For each day the record shows similar to this which I have picked out at random.

Q. Insofar as the detail is concerned?

A. Yes, sir, insofar as the detail is concerned.

Q. Does that volume that you have in your hand now contain the details for the 15,500 determinations that were made?

A. I does.

Q. Each item having as many details as you have just illustrated?

A. I does.

Mr. O'Sullivan: Your witness.

Cross-examination by Mr. Riker:

Q. How much of this work have you done personally?

A. The records were brought in and tabulated. I personally took the records and looked over many of them and then formed a summary, which I prepared, giving many of the essential features, but condensing the work into a space about one third.

Q. Did you take any of the samples yourself?

A. I did not.

Q. Make any of the salinometer determinations yourself?

A. Not for this particular work, only as far as the instruments were made.

Mr. O'Sullivan: And the gentleman who did is dead, you stated?

The Witness: The work was done under the supervision of on behalf of the Metropolitan Sewerage Commission by Mr. David S. Meritt, now deceased.

Mr. O'Sullivan: I might say that I hoped to have Mr. Meritt here, but his death renders it impossible.

Cross-examination by Mr. McCarter:

Q. I suppose at each one of these stations there was an observer?

A. There was.

Q. He would report to Mr. Merritt and Mr. Merritt would make some calculation?

A. Mr. Merritt simply applied the correction which was
2940 given to him by the Metropolitan Sewerage Commissioners, the correction, such as I read out for that particular day, December 10, at 1.1 and he did the manual labor of making that detailed subtraction.

Adjourned to September 10, 1912, at 10:30 A. M.

Supreme Court of the United States, October Term, 1910.

THE PEOPLE OF THE STATE OF NEW YORK, Complainants,
against
THE STATE OF NEW JERSEY AND PASSAIC VALLEY SEWERAGE COMMISSIONERS, Defendants.

Before James D. Maher, Esq., Commissioner.

CORPORATION COUNSEL'S OFFICE,
September 10th, 1912—10:30 o'clock a. m.

Appearances:

Dr. William J. O'Sullivan, Special Counsel for The People of the State of New York, Complainants.
Adrian Riker, Esq., of Counsel for the Passaic Valley Sewerage Commissioners, Defendants.

Met pursuant to adjournment.

2941 EDWARD ELLERY, a witness called on behalf of Complainants, being first duly sworn, testified as follows:

Direct examination by Mr. O'Sullivan:

Q. What is your full name?
A. Edward Ellery.
Q. Where did you receive your information?
A. My preliminary education was had at the Colgate University, where I was graduated in 1890.
Q. With what degree?
A. With the degree of Bachelor of Arts. My subsequent education was at the University of Heidelberg in Germany, where I received the degree of Doctor of Philosophy. I have also been a student at Harvard Medical School, and in more recent years a student at the University of Berlin in Germany.
I have the Master of Arts degree from Colgate, and also the degree of Doctor of Science from Colgate.
Q. What experience have you had in the application of your scientific knowledge?
A. I have been retained by the City of Schenectady in various departments more especially in the Department of Water Works and in the Department of Health in settling questions involving chemical analysis of water and of food.
Q. Before we come to that, Professor Ellery, do you hold any degree from Worcester?
A. No degree from Worcester. I have taught at Worcester Academy. I also have taught chemistry in Colgate.
Q. Do you hold a professorship?
A. I am at present Professor of Chemistry at Union College.
Q. Where?

A. Union College in Schenectady.

Q. Have you been retained by any of the water commissions or boards of health in your capacity as chemist?

A. In addition to that already stated, in connection with the City of Schenectady, I have also been retained by the City of Amsterdam, New York, in connection with cases involving the analyses of their water supply. I am also the chemist of several spring companies in Saratoga, New York; the Adirondack Spring Company, Vichy Spring Company, the Star Spring Company, the Chief
2942 Spring Company. I have been retained by the State Saratoga Reservation Commission—I think that is the title—in connection with the recent purchase by the State of the Saratoga Springs.

Q. Have you been retained as a chemical expert in many cases involving chemical analyses of various kinds?

A. I have been called upon frequently to pronounce opinions as to the purity and safety of water for domestic use by private individuals.

Q. Will you state some of the influences that affect the sewage disposal capacity of waters?

A. First would be the dilution. That is to say the amount of sewage by volume in proportion to the amount of volume of water into which it emptied. Second, would be the forces that might divide the sewage finely. Third, the currents that might carry or transport the sewage away. Fourth, the amount of oxygen dissolved in the water would be a very important influence in determining the sewage disposal capacity of the water.

Q. Which of the two methods in general use known as the Winkler & Levy methods do you employ in making your oxygen determinations?

A. Up to within recent years I used the Winkler method almost exclusively.

Q. And what do you use now?

A. I use now the Levy method to determine the dissolved oxygen.

Q. Will you give your reasons for this preference?

A. The Winkler method makes use of the re-agent known as iodide of potassium, which is exceedingly sensitive to the influence of nitrites in the water and the nitrites we also find in water that is contaminated by sewage. Hence, if a water is very decidedly polluted, the re-agent, potassium iodide, is affected, and one would get a high reading for dissolved oxygen. In the Levy method iron sulphate is used instead of potassium iodide. This is not sensitive to the influence of nitrites, and readings for dissolved oxygen are likely to be more correct from the use of this re-agent than from the use of the potassium iodide reagent. Hence I have discarded the Winkler method and am now using the Levy method exclusively.

Q. For the determination of what?

2943 A. For the determination of dissolved oxygen in water.

Q. I hand you Complainants' Exhibits Nos. 91, 96, 97, 99, 31, 94, and 150 to 157 inclusive, and will ask you to state

what you find in these exhibits as to the relative conditions of the waters of Newark Bay, the Kill van Kull and Upper New York Bay.

Mr. Riker: The question is objected to as immaterial, irrelevant and incompetent.

The Commissioner: Note the objection of Counsel for Defendants.

A. Reading from Complainants' Exhibit No. 97, being average amount of dissolved oxygen in the water in the year 1909, I find that the percentage of saturation, all depths and tides in Newark Bay is 76. In the Kill van Kull it is 79; in the Upper Bay, it is 68; the Passaic River at Newark——

Q. What part of the Upper Bay?

A. It is given here in this list as the Upper Bay. That is an average made up from 80 samples in the vicinity of Robbins Reef. It is evident from those figures that there is a gradual improvement in the water as far as dissolved oxygen is concerned, as the water proceeds from the Passaic River through Newark Bay and the Kill van Kull into the Upper Bay.

Reading from Complainants' Exhibit No. 96, being the average number of bacteria in water in the year 1909, Newark Bay gave a count of 7,400 bacteria per cubic centimeter; the Kill van Kull, 6,500 per cubic centimeter, and the Upper Bay in the vicinity of Robbins Reef 12,500. The Passaic River 92,000 per cubic centimeter. Those figures emphasize the conclusion reached from dissolved oxygen figures, that there is a gradual improvement in the water as it proceeds from the Passaic River through Newark Bay and the Kill van Kull into the Upper Bay.

Reading from Complainants' Exhibit No. 99, being dissolved oxygen in 1911, Newark Bay shows 64 per cent of saturation; the Kill van Kull 75 per cent of saturation; the upper Bay in the vicinity of Robbins Reef 73 per cent. It is evident from those figures that there is a gradual improvement in the water as it comes from
2944 Newark Bay through the Kill van Kull into the Upper Bay and it appears from those figures for dissolved oxygen that the water coming into the Upper Bay from the Kill van Kull is in better condition than the water in the Upper Bay at the vicinity of Robbins Reef.

Comparing the figures for dissolved oxygen in 1909, in Complainants' Exhibit No. 97 with those given for dissolved oxygen in 1911, in Complainants' Exhibit No. 99, it is apparent that there has been a gradual diminution of dissolved oxygen content in the water tributary to the Upper Bay. In 1909, the Hudson River below Spuyten Duyvil shows an average, all depths and tides of 73 per cent. saturation. In 1911, all depths and tides, 56 per cent.

The East River in 1909, all depths and tides, 66 per cent.

The East River at the mouth in 1911, 55 per cent.

The Kill van Kull in 1909, 79 per cent. and in 1911 75 per cent.

The Narrows 1909, 83 per cent. and in 1911, 79 per cent.

It is evident from these figures that waters entering the Upper Bay, from these sources, namely, the Hudson River, the East River

the Kill van Kull and the Narrows, are contributing less oxygen in 1911 than in 1909.

Reading from Complainants' Exhibit No. 150, being a chart of percentage of saturation of dissolved oxygen in the water of New York Harbor, June 21st to July 29th, 1909, and Complainants' Exhibit No. 152, being percentage of saturation of dissolved oxygen in the water of New York Harbor, June 27th to July 28th, 1911, the figures given from the reading of the previous exhibit are confirmed. I would like to say that by comparison of these figures from these two charts it is a safe basis for comparison because the seasons of the year at which the determinations were made are practically the same, and the stations at which the samples were taken approximately the same.

2945 At the mouth of the East River in 1909, the figures given for the ingoing tide are 74, 75, 73, 69 and 61 per cent. of saturation of dissolved oxygen. In 1911 the figures given for the same stations at the mouth of the East River, ingoing tide, are 57, 58, 60, 57, 56. In 1909, the figures at the mouth of the East River, outgoing tide, are 51, 58, 61, 63, 56. In 1911, same station, outgoing tide, the figures are 50, 52, 57, 54, 51. In no instance in these cases does the dissolved oxygen content in 1911 exceed that of 1909. On the contrary, in every case it is less. In 1909, at the mouth of the Hudson River, a station in mid stream, ingoing tide, shows 66 per cent. dissolved oxygen. In 1911, the same station, midstream, mouth of the Hudson River, ingoing tide, shows 60 per cent. At the mouth of the Hudson River in 1909, outgoing tide, 58 per cent. At the mouth of the Hudson River outgoing tide 1911, midstream sample only 50 per cent. In the latter case I say midstream sample only, because in 1909 only midstream samples were taken. The Kill van Kull, Bergen Point in 1909, the water showed 84, 82, 70 per cent. dissolved oxygen, and in 1911, same station, Kill van Kull, 62, 62, 66 per cent. of saturation of dissolved oxygen. At the Narrows, midstream in 1909, ingoing tide, 85 per cent 1911, ingoing tide, same station 83 pey cent. 1909, at the Narrows, midstream, outgoing tide 71 per cent. 1911, same station, outgoing tide, 65 per cent. Comparing these figures showing the dissolved oxygen in the waters flowing into the Upper Bay, samples taken at the same season of the year and at the same station, thus affording a safe basis for comparison, it is apparent that the dissolved oxygen content of the waters tributary to the Upper Bay is diminishing.

A significant comparison of Complainants' Exhibit No. 97, with Complainants' Exhibit No. 99, being averages of dissolved oxygen for 1909 and 1911 respectively, all depth and tides is that the water at the Narrows has diminished in dissolved oxygen, from 83 in 1909 to 79 in 1911. Or, comparing the figures for the flood tide in 1909 it was 92 per cent and in 1911 82 per cent. That is significant to me, because the greatest refreshing action in the mat-

2946 ter of the disposal of sewage in the New York Harbor would come from the water entering the Narrows. That theoretically should be saturated with oxygen. It is apparent from a comparison of those figures that the amount of oxygen in that water

from which we would expect the greatest refreshing action, is decreasing. This can be accounted for by a study of the figures given in Complainants' Exhibit No. 91, being a brief report on the tidal actions in the Harbor of New York in which figures are given showing the division of sea and land water at the Narrows on both ebb and flood currents. Referring to the table containing the figures showing the division of sea and land water in the flood currents figures in millions of cubic feet, out of a total flood, a whole average for the year of 10,780, only 2,210 was new sea water. The remaining part of the volume was a mixture of land and sea water that had already been in the harbor. In other words, practically a little over 20 per cent. of the water entering the harbor at the Narrows at flood tide is new sea water, and approximately 80 per cent. is water that has already been in the harbor and is polluted. That is to say, the amount of oxygen depleted. That to me, is a significant and serious consideration, for, if the streams entering the Upper Bay are contributing no oxygen to the Upper Bay, and the water flowing into the Upper Bay at the Narrows at the time of the flood tide is showing less dissolved oxygen the sewage disposal capacity of the waters in the Upper Bay is gradually approaching a limit.

Referring again to Complainants' Exhibit No. 150, taking the averages of percentage of dissolved oxygen, all tides and depths, the East River at the mouth shows 64.6 per cent.; the Hudson River at the mouth 62 per cent, the Kill van Kull at Bergen's point 78.8 per cent. The Narrows 85 per cent; at Robbins Reef 70 per cent.

From Complainants' Exhibit No. 152, taking the averages in the same way, in the East River 54.6 per cent; at the mouth of the Hudson River, 54.5 per cent; the Kill van Kull, Bergen Point
2947 63.3 per cent. the Narrows 74%, while at Robbins Reef we have 67½ per cent. Comparing those averages we find that the waters of the harbor in the vicinity of Robbins Reef are apparently approaching the condition of the waters tributary to the Harbor.

Measuring the sewage disposal capacity of these waters on the basis of the dissolved oxygen content in the two years 1909 and 1911, it is apparent, first, that the sewage disposal capacity of the waters is not unlimited, and second that it will be only a question of time when the dissolved oxygen would be depleted to such an extent as not only to create a nuisance, but be a menace to health.

Q. The inferences which you draw, Professor Ellery, as to the gradual deterioration of the waters in New York Bay and vicinity, from your studies of the exhibits submitted to you, how do you account for that?

A. It can be accounted for and is supported by the fact that the population in New York has increased and the volume of the sewage going into the harbor has correspondingly increased, and this would all serve to deplete the amount of oxygen in the waters. The population in New York City increased in 10 years from 1900 to 1910, taking the United States Census figures, from 3,437,202 to 4,766,883. That would mean an increase in the volume of sew-

age going into the harbor and a consequent depletion of the oxygen content of the waters.

Q. Have you been enabled by your studies of the exhibits that have just been submitted to you to compute the measure of capacity left in New York Upper Bay to digest sewage?

A. As far as the dissolved oxygen content is such a measure, it appears that it would be only a question of time when the condition in the Upper Bay would be a decided nuisance. All the waters running into the bay are apparently contributing less oxygen, and the waters about Robbins Reef in the Upper Bay show less oxygen in two years 1909 to 1911. It would therefore seem to me to be only a question of time when the amount of oxygen would be reduced to such a point that the conditions in the bay would approach such a condition as to be intolerable.

2948 Q. Can you give us any idea approximately of what you mean by a question of time?

A. If the waters in the vicinity of Robbins Reef have decreased 2½ per cent. in dissolved oxygen in two years, reaching the point in 1911 of 67½ per cent. and assuming that 50 per cent. of dissolved oxygen is absolutely essential in water, and assuming that the same rate of decrease will continue, it would only be a question of 8 or 10 years before the waters in the Upper Bay in the vicinity of Robbins Reef would reach the point, as far as dissolved oxygen is concerned, below which it would not be safe to go.

Q. Have you taken into consideration in your answer just given the addition of such a large volume of sewage as is contemplated in the Passaic Valley Sewerage project?

A. If such a volume of sewage as is contemplated there were dumped into the harbor, my judgment is—unless it were treated—my judgment is that the limit would be reached very much quicker.

Q. How is sewage rendered harmless, insofar as its capacity to give rise to nuisances is concerned?

A. If it can be oxidized, the organic material, the carbonaceous material will be changed into harmless carbonic acid gas, and nitrogenous material into harmless nitrates. For this purpose oxygen is absolutely an essential.

Q. In using the generic term "sewage," Professor Ellery, do you make any distinction as to fresh, stale and septic sewages in their demand upon oxygen, and if so, state why, and what difference there is in the disposition of those different kinds of sewages in the natural processes of disintegration?

A. There is a distinction between fresh and stale and septic or putrid sewage. Eventually they all make a demand upon oxygen. Fresh sewage or sewage that is not putrid makes a direct demand upon oxygen by means of certain aerobic bacteria. After the oxygen has been exhausted, putrefaction sets in through the influence of certain anaerobic bacteria, but the result of such putrefaction, the gases that result from such putrefaction make a demand upon dissolved oxygen just as soon as they come in contact with it, and the oxidation of these gases takes place more rapidly,

2949 that is to say the oxygen is consumed more rapidly than the oxygen that fresh sewage absorbs. Or, in other words, the

mere chemical action in the absence of bacteriological action is a quicker process of absorbing oxygen. I might also add that there are certain ingredients in deposits from sewage which make the demand upon oxygen as, for instance, iron compounds, and there again the absorption of oxygen is much more rapid than the absorption by bacteriological processes.

Q. Professor Ellery, will you state what gases are evolved from fresh sewage from the biological processes you have described as aerobic, and also describe what gases are evolved from septic sewage during anaerobic activity?

A. The largest volume of gas in the first instance due to aerobic action is the carbonic acid gas. There may also be other gases but that is the chief one. In the anaerobic action methane or marsh gas, as it is sometimes called is the largest ingredient, but marsh gas makes a demand upon oxygen, being oxidized into carbonic acid gas by water.

Q. Is that oxidation that you have just described chemical or biological?

A. The latter is a chemical one.

Q. Now, what other gases are evolved?

A. You get sulphuretted hydrogen. This makes a demand upon oxygen, the product of oxidation being water and sulphur dioxide.

Q. Takes gases like hydrogen sulphide, do they readily combine with substances like the paint that is found on the hulls of vessels?

A. If it is lead paint it readily combines and turns the paint dark. If it is a zinc paint, it will combine, but not so readily, and it depends upon the character of the paint. If lead paint it has the action of turning the paint dark, owing to the formation of lead sulphide.

Q. Mr. Ellery, directing your attention to the question of the rapidity of the oxidation process, is it slower in the biological or in the chemical unions of these gases with oxygen?

A. In the biological process it is slower than in the chemical process, the absorption by the gases or by the sediments. The mere chemical process is quite rapid compared with the biological process.

2950 Q. Which kind of sewage more rapidly exhausts the oxygen content of a body of water into which it is discharged, the fresh or the septic sewage?

A. The septic sewage.

Q. In what condition would you expect the sewage proposed by the Passaic Valley trunk sewer project to be brought in a long tunnel sewer from Paterson to Robbins Reef to be when it reached the outfall?

A. Without treatment it would be in a septic condition.

Q. Do you include chemical treatment?

A. I mean if it were not allowed to go through any processes of sedimentation or filteration or treated chemically so that the organic materials were oxidized, either wholly or in large part before entering the sewer.

Q. Would that term "treatment" that you have just employed include sprinkling filters or other methods of oxidizing this matter?

A. Any methods of oxidizing it would of course reduce the organic material and make putrefactive processes slower. I mean by that any process that reduces the amount of organic material in sewage reduces the possibility of putrefaction.

Q. Insofar as it eliminates that much material?

A. Insofar as it eliminates that much organic material that would putrefy. If there is organic material in the sewage when it enters the sewer, the chances for putrefaction are large.

Q. Coming back to that question of the treatment of sewage. May the organic matter or rather may the matter found in sewage be eliminated to the extent of even removing visible suspended particles and still leave an effluent that is highly putrescible?

A. Yes, organic matter might be in what we call a colloidal condition, which is neither solution nor suspension, and yet in that condition the matter is invisible. Such matter is putrescible and when coming in contact with certain precipitants would be precipitated out of the colloidal condition and would be deposited as a sediment. That is all putrescible matter. It is all organic, but you cannot see it.

2951 Q. Professor Ellery have you read the hypothetical question put to the other witnesses in this case?

A. I have.

Q. Taking all these facts and circumstances of record in this case, and facts observed by you, and to which you have testified into your full consideration, what in your opinion will be the results from the contemplated discharge from the Passaic Valley trunk sewer outlet into New York Upper Bay, in the vicinity of Robbins Reef, on the harbor waters and tidal waters of New York Harbor, under present existing conditions and under prospective conditions on or about the year 1940, and during the intervening period between the present year 1912 and the year 1940.

Mr. Riker: The question is objected to on the ground that it does not even appear in this form of the question that this witness has before him any of the facts that are alleged to have been proved in this case.

Mr. O'Sullivan: I will repeat the whole question to him.

The Commissioner: Note the objection of counsel for defendants.

Q. Mr. Ellery, assume that the facts and data have been proven as set forth in Complainants' Exhibits from Numbers 1 to 158 inclusive; assume that these exhibits from Numbers 1 to 158 inclusive, set forth correctly the observations, statistics, chemical analyses, bacterial determinations; photographic reproduction of places and things observed; charts and maps of contours of surface and subsurface localities; apparatus employed, together with the reports made thereon by the observers, and now in evidence in this case, have been proven. Assume, also, that the tabulations of oxygen determinations, the tabulations of bacterial count; the tables of averages for oxygen determinations, bacterial count and harbor deposits; the charts plotting float observations; oxygen percentages, bacterial count, and mud examinations; the current observations,

report of tidal actions, and graphic charts thereof; current velocities, indices of sample stations and plottings thereof; microscopic examinations of harbor deposits, photographs and charts of sewage fields,
dispersion areas, and sleek fields; all as set forth in Com-
2952 plainants' Exhibits from Numbers 1 to 158 inclusive, and
such other scientific data as are included in these exhibits, are proven.

Assume, also, that the testimony which you have reviewed and which has been given by witnesses preceding you in the hearings in the present suit between the State of New York and the State of New Jersey, on all these enumerated matters, and also on the precipitation; run-off; present and prospective populations of the drainage areas, and such other scientific data as has been included in the testimony given thereon, have proven the matters therein testified to—

Taking all these facts and circumstances of record in this case, and facts observed by you and to which you have testified into your full consideration, what, in your opinion, will be the results of the contemplated discharge from the Passaic Valley Trunk Sewer outlet into New York Upper Bay, in the vicinity of Robbins Reef, on the Harbor Waters and tidal waters of New York Harbor, under present existing conditions and under prospective conditions, on or about the year 1940, and during the intervening period between the present year 1912, and the year 1940?

Mr. Riker: The question is objected to on the ground that it does not disclose the assumption of any fact proved by the evidence in this case, upon which the witness is asked to give his opinion as an expert, and for the reasons stated in the objections to the use of this form of question as propounded to other witnesses in this cause.

The Commissioner: Note the objection of Counsel for Defendants.

A. I can answer the question only as far as regards the effect on the dissolved oxygen content of the water. My opinion is that the effect would be to deplete the amount of oxygen in the water and depletion of oxygen results in a nuisance in all waters into which sewage is emptied.

Q. Would you expect a nuisance or a condition of nuisance to follow from the discharge described as contemplated on the part of the Passaic Valley Sewerage Commission?

A. I would expect that.

2953 Q. You would expect what?

A. A nuisance to result.

Mr. O'Sullivan: Your witness.

Cross-examination by Mr. Riker:

Q. What discharge have you in mind, Professor, upon which you based your answer?

A. I have a discharge in mind of sewage containing any organic matter.

Q. You think that a discharge of sewage containing any organic matter in the waters of New York Bay at Robbins Reef would produce a nuisance?

A. I should expect it to.

Q. And in what would that nuisance consist?

A. You would have a surface appearance of the water that would be greasy, oily. The odors arising from the water would be unpleasant odors. That is what I mean by a nuisance.

Q. Is that all that you mean by a nuisance?

A. That is all I have in mind by a nuisance.

Q. And you say that any organic matter, however small, in your judgment, will produce that result?

A. I should expect any organic matter.

Q. Will not you answer my question? I asked you whether you would expect any organic matter, however small, discharged into the waters of New York Bay, would produce the nuisance which you have described?

A. No, I would not say however small.

Q. How much?

A. That would be a very difficult thing for me to say.

Q. That is what I want you to say, if you can?

A. I cannot say that. I could not say so many pounds would produce a nuisance, and fewer pounds would not. I could not say that, but I mean any appreciable amount of organic matter coming in there with the conditions we have got now in New York Harbor, any appreciable amount of organic matter, in there, would increase this tendency to a diminution of the dissolved oxygen, and that tendency would eventually of course, create this condition of nuisance there.

Q. How would it in itself create any condition of nuisance?

A. It would add to the influences that deplete the oxygen

2954 there.

Q. Do you mean anything more than that it would result in the sewage discharged from New York becoming a nuisance in the harbor?

A. I mean that the harbor might become a nuisance through all these influences. That would be one more influence.

Q. And the influence, insofar as it depletes the oxygen in the harbor, decreases the digestive capacity of the waters of the harbor; that is all you mean, isn't it?

A. I do not know that I quite get your question, but I think it means this: that any influence that tends to deplete the oxygen in the water is an influences toward a nuisance.

Q. That is not what I asked you. I asked whether it is not an influence toward a nuisance in that it decreases the digestive capacity of the waters?

A. Will you tell me what you mean by this discharge of sewage into the water? I am perfectly sincere. I do not quite get the meaning of your question.

Q. I do not think I can make in any clearer, Professor, if you do not understand it.

(Question repeated by the stenographer).

A. Yes.

Q. How much original work have you done upon the exhibits from which you have testified in this case?

A. Simply studied the figures; that is all.

Q. How do you know whether they are correct or not?

A. I believe them to be correct. Of my own personal knowledge I do not know.

Q. I ask you again do you know whether they are correct?

A. I do not know that they are correct.

Q. Given a definite amount of sewage in a fresh state, will it exhaust a larger or smaller amount of oxygen than a like amount in a stale state, if discharged in the same character of water?

A. Without question as to time?

Q. Without question as to time?

A. The amount of oxygen absorbed, eventually will be the same.

2955 Q. Is it not a fact that the septic sewage will absorb less than the fresh sewage eventually?

A. Not if it is the same in amount, sir.

Q. You have testified as to your expectations of the character of the discharge from the Passic Valley Sewer, and have said, as I remember it, that you expected it to be septic. How do you reach that conclusion?

A. Modified as I answered the question, without treatment.

Q. Well, as to the stipulation about which you have been asked to testify in the hypothetical question, did not you say you had examined it?

A. I think that I said that I had examined it. I have looked it over, but I am not competent to testify as to it. I am not a sanitary engineer.

Q. Did not you say that you familiarized yourself with it?

A. I do not think I said that.

Q. You have not familiarized yourself with it?

A. I am not familiar with it. I have read it, but I am not familiar with it.

Q. You cannot say that you are familiar with it?

A. Not so.

Q. Can you say that you can testify as to the character of the effluent which will be discharged from that sewage project?

A. I can only testify as to the character of any sewage without treatment, as to the effect of any sewage on water, if the sewage is dumped into the water without treatment, or as to the effect of the sewage upon the water, if I know the character of the effluent. What I have tetsified to here—I think I am correct in saying it—is that without treatment this sewage would have such and such an effect, and I think I also answered the question of Dr. O'Sullivan, as to what I mean by treatment.

Q. Now, Professor, when you testified in answer to that long hypothetical question as to the effect of this discharge at Robbins Reef, did you assume treatment of the sewage there discharged, or did you not?

A. I assumed that *that* there would be organic material in the discharge.

Q. Will you answer my question, please; did you assume treatment, or did you not?

A. I do not know that I assumed anything about treatment.

Q. Is it not necessary to assume something about it, in
2956 order to testify as to the charcter of the effluent?

A. Yes.

Q. Then how did you happen to testify at all?

A. I assumed that there would be organic material in the sewage.

Q. Why did you assume it; what was your assumption based on?

A. There is only one part of that stipulation that I think I based that assumption on, and that is that there might remain in the sewage some organic matter that would be invisible, and that would have the effect of depleting the oxygen in the water.

Q. Now, upon what did you base that assumption. What did you base your assumption on that there would be any such organic substance in the sewage?

A. As I say, there is only one part of the stipulation that fastens itself in my mind, and that is all visible suspended matter is to be removed.

Q. That is the only thing you remember?

A. That is the only thing I base that answer upon; yes, sir.

Q. Well, you think that is a scientific answer to that question, do you?

A. Yes.

Q. You think that is a scientific reply, an expert scientific reply to a hypothetical question as to the effect of a definite effluent, without knowing what that effluent is to be, do you?

A. I do not know what the effluent is. I assume that it is going to have a certain character; certain calloidal matter that is organic. On that assumption I answered the question.

Q. How did you happen to assume that from anything in this case that was before you as a fact?

A. I do not recall that there is anything in the stipulation that demands complete removal of the organic material.

Q. Now, then, coming down to the question of how much organic material can be discharged into New York Bay without producing a nuisance, can you state that?

A. That of course, I cannot state.

Q. Can you state whether there will be in this effluent enough organic material to produce a nuisance in New York Bay, from anything that you know about the stipulation?

A. Absolutely no.

2957 Q. What is sewage?

A. Well, sewage you could not define. It differs so in different communities. Sewage, of course, is excretal matter from the

human body. In various cities it differs in character, depending upon the trade wastes that are allowed to flow into it, which affect it very much. To define sewage as to its exact character, would be impossible. Of course, the organic matter that comes into it, human excreta, is in all sewage.

Q. You cannot state what is the characteristic feature of sewage as distinguished from other waters?

A. All I decline to do is to define sewage. Sewage consists of the excretal matter from human beings, plus all trade wastes that goes into the sewers, plus the surface flow that may get into the sewers.

Q. Well, if you eliminate the human excreta, is it sewage?

A. I should think it might be.

Q. Is there any characteristic ingredient then in sewage, in your judgment?

A. Why, you might have a sewer flowing from a—you mean a distinctive charactertic of it?

Q. Yes.

A. Now, of course, you take the accepted meaning of the term "sewage" and it means the excretal wastes from the human system. That is the accepted meaning of it.

Q. Is there any scientific meaning?

A. I do not think so. Of course, I do not know that. I am only a chemist. I do not know that.

Q. You do not want to express an opinion on that?

A. No, sir; I would rather not.

Q. Well, Professor, do you know the population discharging sewage into the waters of New York Harbor?

A. Only approximately.

Q. Approximately how many are there?

A. I think I will stand on my rights there and decline to answer. I am only a chemist.

Q. You do not want to answer the question because you have not got enough knowledge?

A. That is really the case.

Q. Well, assuming that the sewage from a population of four and one half millions is discharged into the water of New York
2958 Bay, what additional pollution in your judgment, will probably arise from the discharge of sewage from 500,000 more people?

A. All I am competent to say about that is that the amount of oxygen in the water would be depleted.

Q. How much?

A. I could not say.

Q. Cannot you even give a rough figure?

A. I would not want to. There is no definite relation that has yet been established, between the volume of sewage and the depletion of oxygen. There are too many elements that enter into that question.

Q. You would have to know the character of the sewage discharged, for one thing?

A. Yes, and the character of the currents in the water and the influences that would distribute the sewage. You would have to know

lots of things about that. That is a question for a sanitary expert, not a chemist.

Q. Well, would it be possible from a chemical point of view to reduce the oxygen in the waters of New York Bay below 50 per cent?

A. It would be possible to.

Q. One moment, below 50 per cent. saturation, without creating any nuisance of any kind?

A. Not if you continue dumping organic matter into the water.

Q. Assuming you do not continue to dump any organic material into the water?

A. Then you would have more than 50 per cent. saturation.

Q. I am asking you whether it would not be possible to reduce it below 50 per cent?

A. Assuming no organic matter in the water?

Q. Yes, sir.

A. It would be possible by raising the temperature of the water.

Q. Any other way?

A. I do not know of any other.

Q. What about these iron salts?

A. They come from the organic material.

Q. They are organic?

A. No, they come from it.

Q. I am asking whether you could not discharge inorganic substances into the water of New York Bay that would reduce the oxygen below 50 per cent?

2959 A. Surely inorganic material could be dumped in and reduce the oxygen below 50 per cent. and with no organic material, there would be no nuisance, but it must be distinctly understood that there is no organic material there.

Q. That is assumed as part of the question. Do you know what the relation between dissolved oxygen and water may be as to the existence of major fish life?

A. That is not a question a chemist can answer, sir.

Q. Therefore, you would not venture an opinion as to how much depletion of oxygen would injuriously affect major fish life?

A. I would not.

Mr. Riker: That is all.

Redirect examination by Mr. O'Sullivan:

Q. As a chemist you can extract all the oxygen from any given sample of water, can you not?

A. Yes, sir.

Q. And if no organic matter is present in that water, you will have no putrescence, will you?

A. No, sir.

Q. But after extracting the oxygen from the water, if you add putrescible matter, what will happen?

A. You will get a stink.

Q. Mr. Riker asked you some questions relative to the population discharging into New York harbor waters. Are you familiar with

the populations of Jersey City, Hoboken, Weehawken and those other riparian communities in New Jersey?

A. I am not.

Q. You were asked some questions relating to the diffusion of sewage. Do you distinguish sewage from trade wastes, or do you regard sewage as anything that is transported in a sewer, if it is refuse matter?

A. That is my idea of sewage, but I must say again I am not a sanitary expert. My idea of sewage would be anything that goes through a sewer.

Q. And trade wastes may be very rich in organic matter like those trade wastes from silk factories?

A. Yes, sir, decidedly so, any place where they would be using dyes or washing organic material.

Q. Woolen materials?

A. Anything of that sort would be likely to contribute a good deal of organic material to the water.

2960 Q. And do you know of no distinctive characteristic, as long as the matter is organic and is transported in a sewer, you regard it as sewage, do you?

A. That is my understanding of it, but it is what I assume for myself only.

Q. You have not qualified as a sanitary engineer in this case, have you?

A. Not at all, sir.

Q. And you do not know whether or not the means that have been designed to achieve the result would yield the results promised in the stipulation entered into between the Federal Government and the State of New Jersey?

A. I have not qualified to answer any questions about that.

Q. Mr. Riker asked you some questions relative to septic and stale sewage. Assuming the same volume of stale and the same volume of septic sewage being discharged into a given body of water, you were requested to answer whether or not that would deplete that water of the same amount of oxygen. I ask you if stale sewage would become septic if you put no time limit on it?

A. Stale sewage becomes septic just as soon as the oxygen in the water is depleted.

Q. And if you leave it long enough in the water, both the septic and stale sewage would have the same characteristics, would they not?

A. Yes.

Mr. O'Sullivan: That is all.

Recross-examination by Mr. Riker:

Q. Well, Professor, if you discharge a given quantity of fresh sewage into water containing oxygen, do you say it would become septic?

A. If there is not enough oxygen in the water to oxidize it all.

Q. Suppose there is enough oxygen in the water, for instance, to oxidize it all, would it become septic?

A. It is not likely to.

Q. Well, will it use the same amount of oxygen out of that water as if it were septic sewage, provided there is no time limit?

A. The same amount of organic matter will use the same amount of oxygen every time.

Q. Well, Professor, how do you undertake to testify as to the effect of the effluent in New York Harbor, if you are not an expert?

A. I have testified only to the effect of the organic mate-
2961 rial on the oxygen in the water.

Q. And you are assuming that the effluent will contain organic matter?

A. I am; I state that very clearly.

Q. That is all your testimony is intended to mean?

A. I state that very clearly.

Mr. Riker: That is all.

Redirect examination by Mr. O'Sullivan:

Q. If there is sufficient oxygen in a body of water, Professor, will it render septic sewage harmless in a given time?

A. Eventually.

Q. It is merely a question of oxidation?

A. Merely a question of oxidation.

Q. And septic sewage is more rapidly oxidized, if there is sufficient oxygen present?

A. Yes.

Q. Than even stale sewage?

A. Yes.

Mr. O'Sullivan: That is all.

Recross-examination by Mr. Riker:

Q. I want to ask what in your judgment is the difference between a drain and a sewer?

A. When you speak of the word "drain," do you mean a street drain?

Q. I am asking you whether you know what the word "drain" means?

A. I have an idea whether it is your idea of not. When you spoke of the word, I thought of a street drain. If you mean that, I will answer the question. If you mean a drain in a house, one that goes from the water closet, I will answer that. If you mean a drain from a sink, where they are dumping in waste water, I will answer that.

Q. I will put it in this way. Do you distinguish between a drain and a sewer?

A. I never have thought of that especially. If the drain empties into a sewer, I suppose it becomes part of the sewerage system. If it does not empty into the sewer, I do not know what I would say in answer to that.

2962 Redirect examination by Mr. O'Sullivan:

Q. Professor, if it is waste organic matter, whether it goes through a drain or a sewer, do you still call it sewage?

A. If it is organic matter whether it will go through a drain or a sewer, I should call it sewage, but whether it is sewage as accepted by sanitary experts or not, I am not competent to say.

Q. What is there in sewage that attracts your attention most as a chemist, as to its compounds, whether organic or inorganic?

A. The organic material.

Q. No matter what source it is from?

A. No.

Q. That furnishes the problem to you as an expert chemist?

A. Yes, sir.

Q. And that organic material is what draws upon the oxygen in the waters into which it enters?

A. Yes, sir.

Mr. O'Sullivan: That is all, Professor.

OLIN H. LANDRETH, a witness called on behalf of Complainants, recalled for further examination, testified as follows:

Direct examination by Mr. O'Sullivan:

Q. Professor Landreth, have you studied the tabulated work done by the First Metropolitan Sewerage Commission of New York on New York harbor deposits, subsequent to January 1st, 1908, contained in Complainants' Exhibit No. 98, and if so, with what results?

A. I have, with the following results: In Exhibit No. 98, the table gives the station number, location, depth of water, color of mud samples, odor, composition or consistency, and also whether the sample is polluted or not or doubtful. In my study of this data I first grouped together all the sample stations into thirteen different districts or localities, covering New York harbor and adjacent waters, and these districts are as follows:

First, Hudson River,
Second, East River;
2963 Third, Harlem River;
Fourth, Upper Bay;
Fifth, Lower Bay;
Sixth, Newark Bay; and Passaic River;
Seventh, Arthur Kill and Kill van Kull;
Eighth, Jamaica and Gravesend Bays;
Ninth, Long Island Sound, Hempstead, Port Chester and Pelham Bays;
Tenth, Gowanus Bay and Newtown Creek;
Eleventh, Raritan Bay and Cheesecake Creek;
Twelfth, Atlantic Ocean, East of New Jersey;
Thirteenth, Narrows.

In my study of colors of samples I have determined for each

district the total number of samples which were observed for color and the number of which were observed as falling under each of the several colors recorded by the observers. Similarly, in the study of odors I have determined in each of the 13 districts the total number of samples observed for odor and the number of samples yielding each of the odors identified by the observers. I have studied in a similar way the records of the observations on consistency or composition and also for pollution. The results of my studies are tabulated in these tables:

Q. Have you got those tables?

A. I have. Table No. I relating to the study of colors, and Table No. II relating to the study of colors, Table III, relating to the study of composition or consistency; Table IV, relating to the existence of pollution.

Q. Who prepared Table No. I, relating to color?

A. I prepared it.

Q. And have you verified the data that is set forth in this table and compared it with the original?

A. I have.

Mr. O'Sullivan: I offer this table in evidence and ask that it be marked Complainants' Exhibit No. 172.

Mr. Riker: The offer is objected to on the ground that it
2964 does not appear that the offer contains any evidential matter, or that the matter contained in it has been proved in any way, so as to make it the proper subject of an offer as an exhibit.

The Commissioner: Note the objection of Counsel for Defendants. Received and marked Complainants' Exhibit No. 172.

Marked Complainants' Exhibit No. 172.

Q. Who prepared Table No. 2, Professor?

A. I did.

Q. And in the same manner that you prepared Table No. I, did you make your comparisons and verifications?

A. I did.

Mr. O'Sullivan: I offer Table II produced by this witness, in evidence, and ask that it be marked Complainants' Exhibit No. 173.

Mr. Riker: The same objection.

The Commissioner: Note the objection of Counsel for Defendants. Received and marked Complainants' Exhibit No. 173.

Marked Complainants' Exhibit No. 173.

Q. Who prepared Tables Nos. III and IV?

A. I prepared them both.

Q. And did you prepare them in a similar way as to the method of preparation, as Tables Nos. I and II?

A. I did.

Q. With the same verification?

A. Yes, sir.

Q. And comparisons?

A. Yes, sir.

Mr. O'Sullivan: I offer Table III in evidence and ask that it be marked Complainants' Exhibit No. 174.

Mr. Riker: The same objection.

The Commissioner: Note the objection of Counsel for Defendants.

Received and marked Complainants' Exhibit No. 174.

Marked Complainants' Exhibit No. 174.

Mr. O'Sullivan: And I offer Table No. IV in evidence and ask that it be marked Complainants' Exhibit No. 175.

Mr. Riker: The same objection.

The Commissioner: Note the objection of Counsel for Defendants.

Received and marked Complainants' Exhibit No. 175.

Marked Complainants' Exhibit No. 175.

2965 Q. In your studies of harbor deposits do you find conditions such as you describe to exist in New York Harbor are also found in other waters where sewage is discharged into harbors and tidal estuaries and where results similar to those you have testified to have been found, and if so, state the result of such studies?

Mr. Riker: The question is objected to on the ground that it is leading out of all reason.

The Commissioner: Note the objection of Counsel for Defendants.

A. Regarding navigation and the necessity for extensive dredgings to remove sewage deposits, I have found that dredging has to be frequently resorted to at Philadelphia in order to maintain the necessary depth in many of its slips. This is also true at Norfolk, Virginia, Mobile, Ala., San Francisco, California, Chicago River, Milwaukee River, Cleveland Harbor, Cuyahoga River, Buffalo River and harbor, Albany Basin, Oswego River and harbor.

At Belfast, Ireland, in one year, between 30,000 and 40,000 tons of dredgings were made in the Victoria Channel which was largely crude sewage and fecal matter. The channel dredged was nearly half a mile from the sewage outfall and comprised a comparatively narrow strip through the lock. The dredgings therefore represent only a small proportion of the actual sludge deposited in the locks.

In the Thames River, England, following the construction of the outfall sewer, and prior to the installation of the various London sewage disposal works the deposits increased rapidly to such extent that no passage for boats remained where formerly boats drawing 10 or 12 feet of water could pass. The dredgings from the East and West India Docks increased on account of sewage deposits apparently from 60,000 tons to 160,000 tons a year:

Concerning the impairment of health and the spread of disease as affected by the fouling of bridges, docks and wharves the Merchants Association of New York some five or six years ago conducted a series of experiments which indicated that typhoid fever and other intestinal diseases were more prevalent near the
2966 waterfront than in other sections of the city, and traced the cause evidently to the transportation of infectious material from the sludge and sewage deposited along the shores, and on docks and wharves.

Mr. Riker: I move to strike this last testimony out as hearsay.
The Commissioner: Note the motion of Counsel for Defendants.

A. (continued:) Along the Thames in England most typhoid is found where most mud is exposed.

At Brightlingsea, England, on the Colne Estuary, where the sewage was formerly discharged on to the shore the typhoid rate was higher than for the rest of the county, but since introduction of sewage treatment works, the number of cases of typhoid has diminished considerably.

At Newheaven, Sussex County, on the Ouse River, the prevalence of typhoid fever is attributed by the sanitary officer to the deposition of polluted sludge on the shore which is exposed twice a day by the tide.

On the Thames, England, prior to the installation of the sewage disposal systems for London and other cities, offensive mud was brought up by the anchors of vessels. Sailors were affected by nausea to such extent that captains required their anchors and anchor chains to be washed before being brought on deck.

As to effluvium nuisances in relation to sludge deposits may be cited the case of Chicago River and Canal. In the case of the Chicago River and Canal, it was well understood that up to a time some 12 or 15 years ago, sewage was discharged either directly on the lake shore front or largely into Chicago River and Chicago River therefore became a great open sewer. The construction of the main drainage system of Chicago consisted solely in the closing of the sewers which discharged on to the lake front, turning those sewers into the river; the cutting of a channel through the divide, which separated the drainage area of Lake Michigan from the Illinois River, and thereby turning the Chicago River up stream. This work was authorized by Act of Congress, which not only permitted the construction of improvements, but also permitted the
2967 diversion of a large amount of Lake Michigan water into the Chicago River, and thus flushing it up stream, through the Chicago River into the Desplaines River, and thence into the Illinois River; it then got into the Mississippi just above St. Louis. That work was undertaken solely as a matter of sanitary protection, to remove the conditions brought about by the deposit of sewage in Chicago River and along Lake Michigan front.

Similarly at Milwaukee where the water became very foul by the deposit of sewage and sludge, not only from sewers, but also from many industrial works, breweries and otherwise. In summer time when the temperature rose above a certain degree, the matters deposited on the bed of the harbor were accustomed to putrefy. Putrefaction was accompanied by the generation of gases, which tore the deposits of sludge loose from the bottom and caused it to float to the surface, giving rise to offensive stenches, and unsightly appearances of the river front, also robbing the waters of the river of their content of oxygen and preventing their acting as a purifying dilutant for sewage. The effect of that putrefaction was to cause a considerable portion of the accumulated results of the year's

discharge of sewage, to become effective in a polluting way in the few months of warm weather. The City, after careful study of the situation, concluded to construct a flushing tunnel, and did by cutting a tunnel through from Lake Michigan into the Upper portion of Milwaukee Bay, or the lower portion of the river, and pumping, by a large propeller pump a large volume of water from the lake through the tunnel into the river, and thus not only increasing the rate of flow through the bay, the lower end of the river and bay, and thus carrying out of the lake material which otherwise would have been deposited, but also in a more important manner, improving conditions by lowering the temperature of the water in the river, and thus keeping it below the putrefying temperature.

That undertaking succeeded so well,—as to the character of its result, I should say—that its extent was increased later by the addition of another tunnel and now there are at least two tun-
2968 nels in operation securing the same results.

I might say also that partly following the experience obtained in Milwaukee, the City of New York has within the past two or three years repeated a similar effort to improve the conditions in Gowanus Bay, by putting in a flushing tunnel connecting the upper end of the bay with the East River and from that point on the operation is different from what it is at Milwaukee. Thus, far, New York has operated its tunnel by drawing the waters of the Gowanus Bay through the tunnel into the river, rather than by following the custom at Milwaukee of pumping fresh water into the head of the bay. Its operation has resulted in an improvement of the conditions in Gowanus Bay.

At Newtown Creek, the conditions due to the discharge of sewage and petroleum oil waste and other industrial discharges have become so serious that there is an intolerable nuisance and it has led to the suppression of the discharge of many of these wastes into the creek.

In a similar manner, the nuisances, along the Passaic River, from the lower end of the City of Passaic to the upper end of Newark Bay, and for a distance down the bay——

Mr. Riker: Is this testimony in answer to any question?

Mr. O'Sullivan: Yes, sir. Repeat the question please.

(The question was repeated by the stenographer as follows:)

"Q. In your studies of harbor deposits do you find conditions, such as you describe to exist in New York Harbor are also found in other waters where sewage is discharged into harbors and tidal estuaries and where results similar to those you have testified to have been found, and if so, state the results of such studies?"

Q. Proceed, Professor Landreth?

A. Also at Albany New York on the Hudson River, where for many years the discharge of sewage was made directly into the Hudson River, or more properly into a bay or arm of the Hudson, called the basin. That became so intolerably foul as to compel the city to close the basin, to fill its bay and channel and extend
2969 the sewers directly out to the river, where a more extensive dilution would be accomplished. The City is now still further

making improvements in its sewage system, and ultimately will accomplish the treatment of its sewage.

In the Buffalo River at the City of Buffalo, the sewage for several miles along the river has become a serious menace to the health of people living in that vicinity, and has led to the alteration of a number of the sewers, with a view to discharging at different places, so that the sewage may be turned down the river. It has also led to a very extensive study of the further improvement of the river by which the tidal flow of sewage up the river may be prevented by a dam and thus less deposit of sludge shall occur in the river. Also in the Hamburg Canal at Buffalo, which is an artificial channel, originally used as a water way, and after the abandonment of which it became so foul by reason of sewage deposit as to become an intolerable nuisance, and it was some years ago abated by action of the State Department of Health and the City Department of Health.

At the harbor of Cleveland, Ohio, and the Cuyahoga River——

At 1 P. M. adjourned for noon recess until 2 o'clock P. M.

CORPORATION COUNSEL'S OFFICE,
NEW YORK CITY, September 10, 1912—2 o'clock p. m.

OLIN H. LANDRETH a witness called on behalf of the complainants, recalled for further examination, testified as follows:

Direct examination by Mr. O'Sullivan (resumed):

Q. You may proceed, Professor?

A. The harbor of Cleveland, Ohio and the Cuyahoga River, which discharges into the harbor and which forms part of the commercial port of Cleveland. In the summer season, it is virtu-
2970 ally impossible for ship masters to dock their boats for any but the shortest time in Cuyahoga River. In the harbor in front of the City the conditions became so bad as to require not only dredging to keep the slips and the channels clear of sewage, but also made it necessary that the city go into an expensive extension of its water supply in take- tunnel to a point about 7 miles out into the lake, Lake Erie, in order to get beyond the influences of the pollution of the harbor. Even then, at times the water is impaired, and the City has considered seriously, and has had one or two commissioners studying the question, as to what further protection it is possible to accomplish to its water supply.

The next point is Erie, Pennsylvania, which is situated on Presqueisle Bay, which forms the harbor of Erie, and into which the sewage is discharged, and from which, until recently, the water supply was taken. The sewer conditions in the bay have been bad for a number of years and some six or eight years ago, the City began an extensive improvement of its water supply, by which it abandoned taking the supply from the bay and extended a tunnel out across the bay and across the peninsula forming the bay and into Lake Erie, in order to secure water which was not polluted by sewage. The City also finds it necessary to do dredging in its slips and channels, in order to keep the navigable depth.

As Oswego, New York, the harbor of which is formed by the mouth of the Oswego River, the conditions in the lower river became so bad as to be the occasion of numerous complaints, and a few years ago, the State Board of Health was invoked to extend its influences and authority to improve conditions. It did so, first, by requiring that the City should abandon its supply from the river and should take its supply from the lake. Subsequently, that result having been accomplished, it then required that the city should proceed at once toward improvements which should have for their object the removal of the sewage from the river, the treating of it in disposal works and the discharge of the purified effluent into the lake. That work has progressed to the point where
2971 the disposal work representing the sewage of the principal portion of the city, the westerly side of the river, have been designed and are now under contract or are about to be placed under contract. The specifications and plans are all prepared have been for some months, and the contract for the disposal work has either been signed or is about to be signed. That provides for not only the treatment of not only the sewage of all portions of the City, which flows directly into the lake, but, as fast as they can be transferred to it, the sewer outfalls which now discharge into the river, and the works are planned distinctly with the idea of having capacity and character adequate to treat all the sewage of the westerly side of the city, that which flows directly into the lake, as well as that which flows into the river. The State is also requiring that the city shall prepare, before it lets this contract, shall prepare plans for the construction of a similar sewage disposal work, for the eastern part of the City, and will require that that shall be placed under contract within a short period, it has indicated probably within two years as the limit.

At Baltimore, the harbor conditions became so bad up to as long as ten or fifteen years ago, that the City commenced to investigate the matter by its Commissioner of Public Works, or rather by consulting the engineer of the Commissioner of Public Works, Mr. Cohen, who subsequently called in other experts to aid in designing a plan for the rectification of conditions in the harbor. While the chief apparent defects there, were those which are evident to the senses, the sanitation and production of odors, the City was unable to compel any active expenditure towards the improvement until it was able to interest the oyster interests, and in the second commission which undertook the investigation following which the plans were prepared and are now being constructed and operated, the oyster interests played an important part. So that the objectionable conditions there to be rectified, were not only those of the immediate effect on health, and the effect on the senses, but also the financial interests and the influence on that important in-
2972 dustry, oyster raising, which Baltimore depends on and which is an important industry of Baltimore.

At Norfolk, Virginia, the conditions have been so bad there for thirty years as to make the port an undesirable one for travelers and in addition to spending large amounts of money in keeping the harbor and slips free from sewage, the steamers have endeav-

ored to avoid as much as possible the handling of their tourist traffic through the city slips.

To a lesser extent the same is true at some of the smaller ports around the peninsula as Old Point and Newport News, although to a far less extent than at Norfolk and across the river therefrom.

Camden, New Jersey, the deposits of sewage and sludge in the harbor slips have been the source of expense not only to the city, I believe, but I know to some of the large shipping interests there, among them the R. D. Wood Foundry and other shops, which have found nuisances from the river to be very serious during the summer months.

Those are typical cases. I have a great number of other cases that are scattered over the whole country, and I can give you a much more extensive list if desired.

Going to foreign ports, Glasgow, Scotland, a city of more than 750,000 population formerly discharged the whole of its sewage in an untreated condition into the Clyde and the state of the river for several miles below the city was filthy in the extreme; the stench at low water, especially in the summer, being almost intolerable. It has been very materially improved by the construction of artificial treatment systems.

Carlisle, in England, with a population of 40,000 people, discharges its sewage into the River Eden. The whole of the distance from the sewer outfall to the outlet of the Eden is in summer a mass of thick, filthy sludge from 12 to 18 inches in thickness, with gas rising from it and is in a most loathsome state.

In Barking Creek, a tidal tributary of the Thames which receives a large amount of sewage during the summer months, there
2973 are continuous complaints of the odors given off by the mud and the river water.

River Lune: The estuary is without doubt very strongly affected by the sewage of Lancaster which has a population of 40,000. This sewage passes into the river in crude form. In dry weather the river is little less than a cesspool.

Manchester Ship Canal. At Manchester the waters of the canal are foul in the extreme, black in color and emit an odor of sulphuretted hydrogen. They contain no dissolved oxygen and fish life is impossible in them.

At Devonport the estuary is offensive and silting up, owing to the accumulation of sewage.

At Plymouth a nuisance has been caused by a deposit of sewage in Dead Man's Bay and an annoyance at Millbay.

South Shields. One sewage outfall gives rise to much nuisance and a deposit of black, offensive sludge.

Southport. Sludge banks have been formed close to the sewer and along the adjoining channel, giving rise to complaints which have been made for a long time by the inhabitants of Crossness Village, a quarter of a mile from the sewer outlet.

Ireland:

At Dublin, before the construction of the main drainage scheme and purification works, the condition of the Liffey was most filthy,

the river practically a cesspool at low water. Since the completion of the purification works a decided improvement has been experienced.

At Belfast the Lagan was in almost as bad a condition as the Liffey at Dublin, but since the construction of the main drainage scheme commenced in 1889 the condition of the river is quite clean and reasonably free from smell, and no nuisance now arises from it even in the hottest weather.

This is the case to which I referred before where the extension of the sewer brought about a double condition. It improved
2974 the City and it impaired the river or the harbor below by extending the sewage farther down the bay, transferring the foul conditions which formerly existed around the City down farther into the bay.

In Belfast Lough, however, into which the Legan discharges at Belfast, the conditions were rendered worse rather than better by the construction of the main drainage works for Belfast.

The lough is a long, orange-shaped bay or estuary with its point or vertex at Belfast, at the mouth of the Lagan, and the broad extremity or mouth of the lough opening into the Irish Channel. The length of the lough from Belfast to the Irish Channel is about 13 miles and its width at the Irish Channel is about 7 miles. At Cultra, which is about 5 miles below Belfast on the south shore, the lough is about 3 miles in width. The upper reaches of the lough are very shallow and extensive mud banks and sand banks are uncovered at low tide. These banks, which reach almost from shore to shore near the city, and which continue for fully 4 miles seaward on each shore gradually diminish in depth.

Originally and up to some 60 or 70 years ago the waters of Belfast Lough were in their natural condition, were clean and clear, and bathing was freely indulged in quite close to the city, and the green seaweeds of the ulva or enteromorpha species were practically absent. As the population of Belfast increased changes occurred in the nature of the marine vegetation. The zostera or ordinary sea grass gradually gave place to ulva latissima and different species of enteromorpha, both of which began to cause a nuisance when they were washed ashore and putrefied in warm weather. This nuisance, at first sight, became increasingly offensive and eventually so serious as to demand public action. In 1890 a local government Board of Inquiry was held under the Public Health Act (Ireland) of 1878, with reference to an application by the Belfast Board of Guardians, acting as the Rural Sanitary Authority of the Belfast Rural Sanitary District for provisional order to form a united district for the purpose of abating the nuisance, caused (as was then supposed) partly by sewage and partly by seaweed, on the foreshore sit-
2975 uated between Conswater, immediately adjoining the city of Belfast, and Cultra Pier, on the south shore or the lough, in the County of Down—this nuisance being injurious to health—As it was known to be a nuisance which was more or less contributed to by the city of Belfast through its sewage, and by the town of Holywood, situated on the south shore, by its sewage, it was thought reasonable and fair that what is necessary to remove this nuisance

should be done in some degree by each body, the Board of Guardians joining with these other two.

As an outcome of the official action, in the year 1889 a new main drainage system was commenced in Belfast, consisting of two main trunk sewers through the city and two pumping stations, together with a large underground reservoir for storing the sewage previous to discharging it (on the ebb tide only) through a large submarine timber "shoot" which extends for about a mile into the lough.

The effects of the new drainage system soon became manifest in two totally opposite directions. On one hand the condition of the river (at and above Belfast) rapidly improved, the foul mud banks soon got cleaner and the water clearer, and at the present time the river itself is quite clean and no nuisance ever arises from it, even in the hottest weather. But, on the other hand, and quite contrary, apparently, to the opinion of those responsible for the scheme, the state of the lough rapidly became worse, increasing quantities of green seaweeds made their appearance each year and were washed ashore, forming deposits often several feet thick, and these deposits were found much further down in the lough than formerly, and extended in 1907, on the south side of the lough, for nearly 3 miles seawards of Cultra, which place had originally been the limit of the nuisance in 1890. Cultra is about 5 miles down and that makes the extent of the seaweed about 8 miles from Belfast, where it first began to appear.

At Holywood, less than a mile above Cultra, deposits at
2976 least 3 feet thick, absolutely putrid, were being removed from the shore. The nuisance occurring during several months from the putrefaction of these masses of green seaweed, soon became intolerable, a stench extending over a wide area and occasioning not only great discomfort to the inhabitants of the district, but also causing in many cases nausea, headache, and sore throat. White paint on boats, houses, flagstaffs, etc., at times turned black in a single night and silverplate tarnished so rapidly that it could scarcely be kept bright, that being due entirely to the production of sulphuretted hydrogen, one of the products of the decomposition of sludge on the bottom of the harbor. Indeed, occasionally the nuisance was so acute and the evolution of sulphuretted hydrogen so extensive that paper moistened with acetate of lead solution, held near one of the seaweed deposits, turned black in a few moments.

Fresh remedial measures were obviously imperative, and as by this time it had been clearly demonstrated that the nuisance was caused by seaweed and seaweed only, and not directly by sewage matters intermingled in them, and further, that the growth of these particular seaweeds is encouraged, or rather depends upon, sewage pollution of the water, it seemed clear that the main drainage scheme for Belfast was largely responsible for the trouble, and therefore the city was largely responsible.

As a consequence extended and varied investigations followed, the objects of which were mainly directed to an exhaustive study of the direct cause of the nuisance, namely, the ulva latissima, as a preliminary to any intelligent design for sewage purification works,

as it was clearly recognized that since the ulva depended on the presence of the sewage pollution, absorbing therefrom both ammonia and nitrates, it was essential that any scheme of sewage purification which should successfully eliminate the nuisance from ulva latissima, must be so designed as to remove the maximum feasible amount of the ammonia and nitrates. Even with such a system successfully designed and installed, so as to effectually prevent the further growth of ulva latissima, it is recognized that the existence of the large deposits of sewage sludge in the harbor would tend for a long time to continue the conditions favorable to its growth, and that the immediate disappearance of the ulva latissima from the lough should not be expected to follow immediately on the installation of sewage treatment works. In other words, not until the accumulation of sludge on the bottom of the lough which had been gathering for many years, should become reasonably decomposed and purified, not until then would the trouble from the ulva latissima entirely disappear.

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As to the prevention of mud by reason of the precipitation of mud and sewage deposits and the casting up of the same on bathing beaches, it may be said that this has occurred not only at New York, but at Philadelphia, certain parts of Boston Harbor, Lake Michigan, Chicago, near the mouth of the Chicago River, prior to the construction of the Chicago Drainage Canal; Milwaukee near the mouth of Milwaukee River; Cleveland, as well as at numerous other American and European cities, where bathing beaches, situated not very remote from sewage outfalls have been destroyed by the casting up of sludge by the water action from the bottom of the harbor, so as to render the use of the beaches practically impossible.

Q. May deposits of sewage matters be formed which would actually interfere with navigation?

A. Yes, sir, that has been observed and it has been found necessary to dredge away at considerable expense.

Q. Now, as to effluvium nuisances, Professor Landreth. Have your investigations discovered that they occur in any tidal waters?

A. Yes, in numerous cases effluvium nuisances, as they are called, occur in certain tidal waters, where the volume of sewage discharged into them is relatively large in proportion to the tideway itself.

Q. How does this kind of nuisance originate?

A. This kind of nuisance may originate from a putrefying mixture of liquid sewage and water, but in the majority of cases, I believe it to be due rather to foul deposits of sewage solids.

It is simply necessary to refer to the phenomena that attends the discharge of sewage into natural waters, to see in what two ways effluvium nuisances may occur. In the first place the free discharge of sewage directly into waters is liable to produce odorous nuisances directly from the fresh sewage, but that is comparatively limited in extent and in time, and soon disappears. It disappears simply because the oxygen contents of the waters are usually sufficient to interrupt the odorous bacteria, that is to say the anaerobic bacteria from carrying on their putrefactive decomposition,

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and there sets up in place thereof the aerobic or oxygen reduction of the sewage. That being odorless, the first form of odor soon ceases. But on the other hand, very shortly the supply of oxygen in the waters is exhausted, and at the same time the particles of sewage settle to the bottom, and usually they find conditions favorable to the working of anærobic variety of bacteria, and their products are putrefactive and highly odorous. Their products are both liquid and gas. In other words, then tend to liquify the solid matter and to gasify it. The gasification is carried on in the midst of the mass of decaying matter, and the gas is not finally discharged, but it is contained in the interior of the mass. It is the same thing that we find floats up a body. When the gas evolved is of sufficient volume to buoy up the carcass to the surface, it floats up. The production of that gas goes on slowly when the temperature is low, rapidly with a high temperature, because the bacteria themselves require for their best activity a certain range of temperature and that temperature is only reached during certain of the warmer months of the summer and autumn. So that while that decomposition may be going on for twelve months of the year, it frequently does not become serious enough to cause the gas to buoy the sludge until the summer months have increased the volume of gas sufficiently to tear the solid matter free from the bottom and cause it to float on the surface, and when it floats it brings up not only the actual chemical gases, the marsh and other gas, but also the sulphuretted hydrogen and other bad odors and we have, therefore, the effluvium nuisance brought about at the same time that these gases are being discharged at the bottom
2979 of the river, rising in bubbles and combining chemically with the oxygen content of the waters. Those two dual operations almost always go on together.

Q. What gas is it that is the main cause of the nuisances that you are describing?

A. Sulphuretted hydrogen is one of the principal gases which attends the secondary or later decomposition of sewage. That is not at all the odor of sewage. The odor which smells like sewage comes generally from fresh sewage, new sewage, but the most offensive odors are those which come from old or stale sewage on the bottom, and those odors are largely attributable to sulphuretted hydrogen or some of its mixtures.

Q. Now, have you made investigations relative to the effect on health of these exposed mud banks in estuaries polluted by sewage?

A. Yes, sir, I have. I have a long list of citations of location of nuisances of the effluvium sort which I was intending to give.

Q. Of effluvium nuisances?

A. Yes, in further answer to your last question. I have explained the general nature of them, but I have collected a good deal of information as to the existence of these effluvia nuisances at various points. Do you wish me to give them?

Q. Yes.

A. Glasgow. A city of more than 750,000 population, formerly discharged the whole of its sewage in an untreated condition into the Clyde and the state of the river for several miles below the city was

filthy in the extreme, the stench at low water, more especially in the summer, being almost intolerable.

The same may be said of Lancaster where the odors are mainly those of a cesspool.

Carlisle with a population of 40,000, also discharges crude sewage into the river Eden. The outfall sewer is about half a mile below the city, the tide flows up within a mile of that. The whole of the way down to the outlet of the Eden is in the summer a mass of about 12 inches to 18 inches thick of filthy sludge at the bottom, with gas rising from it,—it is in a most loathsome state.

The Barking Creek is a tidal creek which goes from the Thames through Barking to Ilford, where a large quantity of sewage
2980 is cast into it, and complaints have been made chiefly in connection with nuisances arising from the smell, the latter being worst where the waters of the creek have received the sewage of about half a dozen different towns. Then the sewage of East Ham is backed up by the tide also as far as Barking Town, so that altogether the sewage of a population of about 200,000 passes through the town of Barking or is washed up to that town, and there a great deal of stagnation occurs with deposition of black mud. During the summer months there are continuous complaints of the odors given off by the mud and the river water, which probably at some times is more than half of it sewage or sewage effluent.

The River Lune. The estuary of this river is without doubt very strongly affected by the sewage of Lancaster (population 40,000) and district, which passes into the river without any treatment, especially in the dry weather, when, according to reports of the water bailiffs, it is nothing less than a cesspool.

Manchester Ship Canal. Although this canal cannot be described exactly as an estuary, it is in a sense of a similar nature. The condition of the water in the Manchester docks (Trostle Nest Dock) is foul in the extreme. The waters of the canal at this point were inky black in color and emitted an odor of sulphuretted hydrogen. They contained no dissolved oxygen and fish was quite impossible in them.

At Chatham the foreshore is polluted in many places.

At Rochester nuisances are frequent from accumulations of sewage-polluted mud in the creeks and rills.

At Southshields one sewage outfall gives rise to much nuisance and a deposit of black, offensive matter.

At Cardiff there is an occasional deposit of sewage on the river's bank and on the foreshore.

At Carnarvon the mud deposits at the mouth of the river are to some extent impregnated with sewage.

2981 At Stockton-on-Tees bad odors will sometimes be noted, the mud deposited on the banks of the river no doubt containing sewage solids.

At Swansea some complaints have been made and sludge is said to be found opposite to the outlet of the main sewer.

Answering your question which bears on the matter of the effects on health of exposed mud banks, it has been found along the Thames,

most typhoid is found where most mud is exposed. Towards Grays there is no mud. It is only below Canvey Island that the mud is exposed. Below grade, the typhoid fever rate increases enormously.

At Brightlingsea on the Colne estuary, where the untreated sewage was formerly discharged onto the foreshore, the typhoid rate was higher than for the remainder of the county.

In the tidal Ouse (Hampshire) in relation to the prevalence of typhoid fever in the adjoining districts, especially at Newhaven, situated at the mouth of the river, the conclusion is that the river itself was responsible for this prevalence, and as a consequence of the discharge of sewage containing excreta of patients suffering from the disease into the upper reaches, and mainly at the town of Lewes.

Regarding the polluted river then as the cause, the town of Newhaven is exposed to the risk of infection in two ways:—First, by the deposition of polluted sludge on the foreshore, which is exposed twice a day to the tide, and, secondly, by the pollution of the rather extensive mussel layings which are situated in the upper harbor.

Q. What effect have the tidal or non tidal streams on disease germs?

A. There is a very striking difference between the effect produced by tidal streams and non-tidal streams on disease germs. In the case of non-tidal streams not only does dilution come into action, but the organisms are deposited along with the suspended solid matters of the sewage on the bed of the stream. The disappearance of these disease producing organisms is due to the fact that they are
2982 best adapted for growth in connection with some living organism, so their environment at the bottom of the river is unfavorable for them. Therefore, in the struggle for existence between them and the bacteria naturally found in a good river water, the disease-producers are at a heavy disadvantage, cease to multiply and die out.

But in the case of a tidal stream the conditions are different. Here the disease-producing bacteria are deposited not only on the bed of the stream, but also on the mud and sludge on the banks and are uncovered at low tide.

It now requires only the agency of a fly, feeding first on the organic matter in the sewage contaminated mud and then on some human food,— milk, for instance,—to convey the bacillus of typhoid fever from the river to some human being.

Q. In South Wales, did they trace that contagion?

A. Yes. The contagion was found to be due to the transference by some means of transport or other from the polluted foreshore directly to the food supplies, the water supply and the drainage both being beyond question.

Belfast is a city in which typhoid fever is very prevalent and formerly the whole of its sewage was discharged in the crude state into the lough, where the tides are sluggish and extensive mud and sand banks are exposed at low tide.

Apart from the direct conveyance of the animal disease germs, organisms, there is a well established belief among medical men and sanitarians that the emanations from sewage, no doubt, from putre-

fying organic matter, are in general detrimental to health, and induce vomiting, diarrhea and prostration, and that such emanations, even when largely diluted may lead to minor ailments, such as headache, ills of appetite, and a general lowering of health.

In a weakening of the general constitutional vitality of individuals, they are thereby exposed indirectly more readily to attacks of direct infection. It used formerly to be the impression among
2983 medical and sanitary officers that typhoid fever was produced simply and solely by unsanitary conditions as to air, drainage and sunlight. It is now known that although there is some ground for that belief, it is known that the direct conveyance of the disease is not at all due to these unfavorable conditions, but is due to the specific infection by a particular bacillus, and, on the other hand, these unfavorable conditions lay the ground and prepare the way for the entry of the germ into the human system, but for which the human system would be able to successfully resist. So, the production of bad air along ponds and the rivers and the emanation of bad gases have a harmful effect in two ways, not only in the direct danger of conveying the infection of the disease, but also in a preliminary way by laying the ground work for the successful attack of a disease when it occurs, by reducing the natural vitality of the individual to a state where the system is not able to successfully resist the inroad of the specific germ. In my observations as consulting engineer of the State Board of Health, I had numerous cases,—many of them I recorded, others, they were so numerous that I have not kept any record—in which the water supply would be infected with typhoid fever in a moderate degree, and some people would contract the disease, and others not. Invariably the people who contract the disease are those whose vitality has been lowered, and depressed by some unsanitary conditions of some sort, or perhaps by some organic malady, which has left them in a depressed state of health. Invariably they are the people who contract the disease, when it is not strong enough to attack the general mass of people. Of course an infected water supply may be so strongly infected that it attacks a large proportion of those who take the water, but in just the proportion that that degree of infection is weak, in just that degree does the individual of low vitality succumb to the disease and the individual of strong vital condition resist it. Now, the prevalence of mud banks, giving off bad odors, I repeat,
gives rise to two sets of conditions: it not only tends to furnish
2984 the infectious germ, but also tends in a preliminary manner to lay the way for that germ to become successful in entering the human system.

Q. How is the sulphuretted hydrogen liberated from the foul deposits that you have described?

A. Well, it is produced in the bacterial decomposition of the organic matter and exists in the form of minute globules of gas interior to the organic substance. When the evolution of that gas becomes sufficient for those bubbles to coalesce, flow together, and when that large bubble is able to either lift up the organic matter or break away from it, then it rises up through the water, frequently

bringing up with it a little particle of solid sludge, sometimes coming up simply as gas, and breaking at the surface of the water.

Q. The decomposition of what bodies yield sulphuretted hydrogen?

A. Well, the sulphides of the water are combined with the organic products of the organic matter and give us sulphuretted hydrogen.

Q. Is it chiefly from albuminoid bodies?

A. Largely, yes, sir.

Q. Is it the product of bacterial life?

A. It is directly; yes, sir.

Q. Can it be occasioned by the reduction of sulphates?

A. The first portion of it is the immediate product of bacterial life; the latter part, purely chemical combination. The reduction of the organic matter to the form of ammonia, is strictly a bacterial action.

Q. Now, there are certain properties of this foul mud I wish you would throw a little light on, Professor. That is, its capacity for suspension in tidal reaches of certain estuaries?

A. Yes, sir. That is one of the immediate results of what I have already explained.

Q. Will you explain how that is occasioned?

A. That question has been pretty thoroughly investigated and studied. It seems to be pretty well established that the intimate commingling of the river water with its bed caused by a rapid current on the one hand and finely divided particles on the other, must lead to fairly rapid chemical changes in the water—supposing the mud or silt to form in the river's bed to be polluted.

2985 Has that given rise to any questions?

A. Yes, sir.

Q. Questions relating to the localities and analyses of the deposits for instance?

A. It gave rise to questions which have led to very extensive chemical investigations.

Q. Now, taking a sample of this black and slimy mud that you have been describing, with a strong odor of sulphuretted hydrogen, what occurs when it is exposed to the air. Does it change in color, and if so, state to what?

A. There is a change in color by which the organic matter turns black when the gas is liberated. The gas combines with the oxygen of the water, and tends to deplete the supply of oxygen in the water, so that when water otherwise well aerated is exposed to sludge banks which are discharging gases, the oxygen content of the water is very rapidly exhausted by chemical combination with the gases, and as a result the waters have their capacity for purifying organic matter entirely destroyed, and as a further result the odors themselves become obnoxious.

In the case of Chicago River, while the waters of Lake Michigan are well aerated, sometimes to the point of saturation, when the water enters the river and flows but a short ways, its entire oxygen content has been depleted, and it is found to be practically devoid of oxygen. That is water which has not touched the bottom at all,

which has simply flowed past a rising stream of bubbles of gas from the bottom, indicating that the action is rapid and probably simply a chemical action, in which bacterial activity plays no part other than to produce the stock of gas on the bottom of the river. That occurs very quickly, very rapidly, and in that respect it is entirely distinct from the bacterial activity in reducing compressed organic matter down to the ammonia and nitrates and nitrites, which is rather slow.

Q. Are you familiar with any set of experiments, made to determine the loss of dissolved oxygen from waters in contact with such mud samples, as you have described?

A. Yes, sir. In the report of the Royal Commission on Sewage Disposal of England, submitted in 1908, being the fifth
2986 report in Appendix 6th, is an account of a series of investigations made by and under the direction of Adeney and Letts.

Two liters of tap water were repeatedly shaken with renewed air for 10 minutes, and then placed in an incubator at 80 degrees F., for 48 hours. 20 grams wet mud were then placed in the water, tightly stoppered, well shaken, and returned to the incubator. At the end of the period of incubation the dissolved oxygen remaining in the water was determined.

The results Experiment 1, Mud Sample No. 1, Period 3 hours:

Dissolved oxygen originally present	5.85 cc. per litre
Dissolved oxygen lost	2.49 cc. per litre
Per cent. of original dissolved oxygen lost	42.5 per cent.

Experiment No. 2, Mud Sample No. 1, period 6½ hours:

Dissolved oxygen originally present	5.85 cc. per litre
Dissolved oxygen lost	3.60 per litre
Per cent. of original dissolved oxygen lost	61.5 per cent.

Experiment No. 3, Mud Sample No. 1, Period 10 hours:

Dissolved oxygen originally present	5.85 cc. per litre
Dissolved oxygen lost	5.19 cc. per litre
Per cent. of original dissolved oxygen lost	88.7 per cent.

Experiment No. 4, Mud Sample No. 2, Period 3 hours:

Dissolved oxygen originally present	5.85 cc. per litre
Dissolved oxygen lost	4.50 cc. per litre
Per cent. of original dissolved oxygen lost	77.7 per cent.

Experiment No. 5, Mud Sample No 2, Period 6½ hours:

Dissolved oxygen originally present	5.85 cc. per litre
Dissolved oxygen lost	5.55 cc. per litre
Per cent. of original dissolved oxygen lost	94.9 per cent.

Experiment No. 6, Mud Sample No. 2, Period 10 hours:

Dissolved oxygen originally present	5.85 cc. per litre
Dissolved oxygen lost	5.75 cc. per litre
Per cent. of original dissolved oxygen lost	98.3 per cent.

2987 Q. In these experiments what percentage of moisture did the mud contain?

A. The mud contained 64 per cent. of moisture, therefore in each bottle there was a quantity of 7.2 grams of dry mud. In the second mud samples there was 49.8 per cent. of moisture. Therefore in each bottle there was a quantity of dry mud represented by 9.97 grams of dry mud and two liters of water. That is 2,000 grams of water and 9 or practically 10 grams of dry mud. In other words 1/200ths of the weight of the water was able to reduce the oxygen in the water by 98 per cent. of its amount to nearly all, showing that a very small relative weight of mud on the bottom in a putrid condition may destroy the oxygen contained in many times the weight of that mud of water standing over it.

Also another set of experiments were made on samples of deposits from the Thames, which were collected for the purpose by Dr. W. W. Willoughby, Assistant M. O. H., for the Port of London. The method was to saturate with oxygen a large sample of tap water and to place in the water samples of muds to be tested, amounting to 12.5 grams (averaging 3.76 grams dry mud) per litre of water. The bottles containing the water with the mud samples were placed in an incubator and were thoroughly agitated at hourly intervals. At the end of the stated intervals the bottles were removed from the incubator and samples of the water subjected to dissolved oxygen determinations. The composition of the mud samples as well as their effects on deoxygenating the water are shown in the following table:

Q. Have you got that table with you?

A. I have.

Q. What does this table show, Professor Landreth, in general terms?

A. It shows in the center of the table under the head of "Remarks" a description of the kind of mud contained in each of the samples. Those samples are referred to on the left hand margin by the dates, and by the place where the sample was gathered, and in the three following columns, by the chemical characteristics of the mud samples themselves. To be more explicit, Column 1

2988 gives the gate, Column 2, gives the serial number, Column 3 gives the location of where the sample was collected, Column 4 gives the percentage of loss of the mud on ignition, which is one of the chemical data necessary to describe the mud. Column 5 gives the percentage of nitrogen in the mud. Column 6 gives the probable percentage of sewage sludge in the mud, varying in these cases from 1.3 per cent. up to 13.9 per cent. of sewage in the mud. Of course much the larger portion of the mud is simply mineral silt content lying on the bottom of the harbor and precipitated probably along with the organic sludge out of the water. Column 7 gives—

Mr. Riker: One moment, are you going to read from that?

Mr. O'Sullivan: No, I will offer it. I offer in evidence the table just described by this witness and ask that it be marked Complainants' Exhibit No. 176.

Cross-examination by Mr. Riker:

Q. Where did you get this table?

A. I took that from the report of the Royal Commission on Sewage Disposal, to which I referred in describing the experiments.

Q. It does not contain any work by you?

A. No.

Q. Do you know whether these data are true?

A. I have every reason to believe they are.

Q. I ask you whether you know they are?

A. In a sense I know they are true.

Q. How do you know?

A. I know by the fact that the results in the first place have passed the tests of scientific inspection, and in the second place they have been officially recorded and officially published as the Royal Government Report.

Q. You say that you know that these particular examination- have been verified do you?

A. Yes.

Q. How do you know that?

A. By the description of the procedure in the text.

Q. How do you know that the procedure was actually applied to them?

A. I am dependent there on certain presumptions that
2989 when a person records a thing in a document of an official nature, it is presumably the case that he is stating the truth.

Q. And the knowledge that you speak of as the basis of this table is presumption, is it not?

A. No, sir.

Q. What is there that you are relying upon except your presumption that the official reports are correct?

A. My knowledge in general based on experience in official documents, and the preparation of them and the care exercised in their preparation, and the scrutiny and checks placed on them. When an official document runs the gauntlet of numerous tests, first in the field, then in the laboratory, and then in the official office, and finally receives the stamp of the official responsible by his sworn duty to carry out his functions, then we may say that we know that their results are true, short, however, of actual, personal, visual seeing.

Q. Who took the samples, do you know?

A. Yes.

Q. Who?

A. It is indicated in the table and the text here. Dr. Willoughby made the selection.

Q. He took the samples, did he?

A. Yes.

Q. Is it stated so?

A. It is stated that he and his assistants took the samples. I will read it, if you wish me to.

Q. I am asking you what you know about it?

A. I know that Dr. Willoughby and his assistant took the samples.

Q. Who is his assistant?

A. I do not know his name. I do not at least recall it.

Mr. Riker: I object, as this table is based entirely on hearsay, and is not competent, relevant or material.

The Commissioner: Note the objection of Counsel for Defendnats.
Received and marked Complainant's Exhibit No. 176.
Marked Complainants' Exhibit No. 176.

2990 Direct examination by Mr. O'Sullivan (resumed):

Q. Is it a usual thing, Professor Landreth, for chemists, bacteriologists and engineers to follow the lines of procedure laid down in these reports furnished to European Governments through these Royal Commissioners and verify the procedure as to the results obtained?

Mr. Riker: The question is objected to on the ground that it is immaterial and irrelevant.
The Commissioner: Note the objection of Counsel for Defendants.

A. It is customary to follow the procedure so far as applying the tests of accuracy and reliability and care and verification of the reality of the data, but it is not customary to make experiments of this sort. These are comparatively recent in their determinations, and it does not represent a very large field of experiments which have yet been made, but I may say that since that was made, a number of other similar investigations have been started and the method proposed here has been followed in a number of cases. Our own commission in 1906, undertook work somewhat similar, but not just in this line. If, however, your question deals with the procedure as to the verification of the statements, then I will say that it is entirely in accordance with the methods followed for years in ascertaining that published results, and especially the official portion of published results, express what they purport to show and accurately express them. It is the custom in scientific laboratories, where it is known that a certain experiment is to be made a matter of official record, for all of the force from the Chief of the laboratory down, to exert more than usual care, knowing that legally such documents are entitled to legal consideration and acceptance where an ordinary scientific paper would not be.

Q. And when a table like this is printed, is it held out to the entire profession of the civilized world for criticism and verification?

Mr. Riker: The same objection.
The Commissioner: Note the objection of Counsel for Defendants.

2991 A. It is held out usually without question as to the accuracy of its result.

Q. Have you ever heard the accuracy of these results questioned?

Mr. Riker: The same objection.
The Commissioner: Note the objection of Counsel for Defendant.

A. I never have.

Q What do you infer from that series of experiments as set forth in Complainants' Exhibit No. 176?

Mr. Riker: The question is objected to on the ground that it is immaterial and irrelevant and not a proper hypothetical question, inasmuch as the basis of it has not been proved in the case.

The Commissioner: Note the objection of Counsel for Defendants.

A. I conclude that the results reached by this series of experiments were strikingly similar to those conducted at a different time and at a different place and testified to by me before, and that the dissolved oxygen content in the waters was robbed of its oxygen by the mud mixed with it, by percentages varying from 43.5 per cent. up to 92.7 per cent. For example, sample No. 3 shows after three hours a loss of 43.5 per cent. of its original dissolved oxygen. Sample No. 4 shows a loss of 62.6 per cent. Sample No. 2 shows a loss of 69.8 per cent. Sample No. 3 at 3 hours mixture shows a loss of 76.6 per cent. Sample No. 4 after 6 hours' mixture shows a loss of 80.8 per cent. loss in its oxygen. Sample No. 2 after 6 hours' mixture shows a loss of 92.7 per cent. of its oxygen.

Q. Now professor Landreth, grouping these and taking one part of dry mud to 266 parts of water, state how that would operate in reducing the dissolved oxygen and in what percentages the oxygen is reduced.

Mr. Riker: The same objection.

The Commissioner: Note the objection of Counsel for Defendants.

A. Such a mixture of one part of dry mud to 260 parts of water reduces the dissolved oxygen an amount varying from 43.5 per cent to 93.7 per cent. of the originally contained oxygen content of the water.

2992 Q. Do these experiments indicate the disappearance and the rate at which that disappearance occurs as to the dissolved oxygen present in the water?

Mr. Riker: The same objection.

The Commissioner: Note the objection of Counsel for Defendants.

A. They indicate that the dissolved oxygen per cent. in a given water may disappear with considerable rapidity if the water is in contact with the foul mud. There can be no question that this is a matter of considerable practical importance in relation to rivers like the Thames, Humber, Usk, etc. which are very muddy and contain sewage solids. It seems also probable that the low amount of dissolved oxygen found in the more polluted portion of these streams is due quite as much to the presence of these solids as to the liquid parts of the sewage discharged into them.

Not only is the oxygen content reduced, but also the decrease of nitrates goes on. It should be said that while nitrates are not a

purifying element in the water, they represent a pretty advanced state of purification of the organic matter. When organic matter is decomposed, has passed from a highly complex state by bacterial action to simpler chemical *chemical* components, the first of these is the production of ammonia and then the production of nitrates and nitrites and when the decomposition has been carried to that point, there is really no need for bacteria to reduce it any farther, provided there is plant life present in the water to absorb it, because plant life can absorb as food the nitrates and nitrites. Consequently it is evident that in the cycle through which organic matter passes in going up from chemical elements, and simple chemical components, into vegetable tissue, and thence passing into the animal system, into animal tissue, it is an ascending grade, and it gets more and more complex. When death occurs and the cell ceases to retain its capacity to absorb more chemical elements, to grow, and propagate itself, then destruction begins, and in the descending grade, bacteria come in to aid in the decomposition, and they decompose it from the more complex to the more
2993 simple, and they carry that down at least to the extent of nitrates and nitrites and in some instances they carry it down still farther. Usually you have nitrogen given off as one of the ultimate last elements. Now, when polluted water is examined for its content and found to contain the nitrates and nitrites, it is very evident that it was derived in most cases from the decomposition of the originally complex organic matter. Now, when foul muds lie under waters which have progressed part way down the scale of decomposition, and have had their complex organic matter partially purified or decomposed and reduced down to the stage of nitrates and nitrites, then that should be counted as having reached that stage in the progress toward purification. But if something interferes to undo that, and set it back again, then it becomes necessary for that to be done over again. It has been found that these foul odors which arise from mud passing up through the waters cause a reduction of these nitrates and nitrites. They cause a retrograde result, and whatever retrograde result is reached calls for an equal progressive step to be done over again. So the influences of these foul odors lying over the foul mud is a retrograde action and it tends to undo something that has been done.

In the same report that I have referred to Letts and Adeny made experiments to determine what, if any, effect will be produced on the exhaustion of nitrates in harbor waters by the presence of foul muds.

The first series of experiments consisted in mixing a sample of the same mud as formed Sample No. 1 of the deoxygenating experiment described above, with Sprinkler effluent from the Belfast sewage disposal plant, examining the nitrogen contained at the end of the stated periods, extending to 48 days.

The weights were as follows:

9.36 grams (dry weight) of mud from Sample 1.
10.64 " of water.
200 " of sprinkler effluent.

2994 The results of the experiment were as follows:

Period of incubation at 80 degrees F. Days.	Per cent. of nitric nitrogen.	Per cent. of nitric nitrogen destroyed.
00	100.0	0.00
16	63.6	36.4
32	12.1	87.9
48	9.7	90.3

The second series of experiments was of the same nature except that instead of sewage effluent, a solution of known strength of patassium nitrate was used. The weights were:

5.08 grams (dry weight) Mud Sample No. 2.
14.92 " of water.
200 cc nitrate solution.

Period of incubation at 80 degrees F. Days.	Per cent. of nitric nitrogen.	Per cent. of nitric nitrogen destroyed.
0	100.0	0.0
16	86.0	14.0
32	8.6	91.4
48	2.2	97.8

It should be explained that in the former experiment the sample was selected from the sewage disposal filtration work at Belfast and the sample being a sample from the discharged effluent as it came from the plant ready to be turned out purified into the waters of the lough, and it was on that sample that the loss of nitrogen here stated was determined.

It goes without saying that it became necessary there to examine a sample in which was a definite determined amount of nitrates and nitrites present, but that the same result would take place in the case of any harbor water where bacteria had already reduced the organic matter to nitrates and nitrites. The same process would take place.

Q. Now, as to the evolution of ammonia from these foul muds?

A. Well, the same experimenters Messrs. Letts and Aderney conducted a series of experiments by which they showed that the
2995 nitrates destroyed by the muds were converted into ammonia. If we find that the nitrates are destroyed we begin to suspect that the ammonia has probably increased, and this third series of experiments was for the purpose of verifying that fact and showing that the decrease of nitrates did not take place in any other direction than go backward.

Q. And this retrograde condition was brought about by decomposition?

A. Yes, sir, entirely.

Q. So that it not only polluted but actually retarded the purifying process in that respect.

Mr. Riker: I object to it as grossly leading.

The Commissioner: Note the objection of counsel for defendants.

A. Not only retarded it but actually set back the process and required it to be done over again.

The experiments were conducted on the same samples of mud and in a somewhat similar manner to the previously described experiments on the deoxygenating effect of the muds.

20 grams of wet mud (containing 55.9 per cent. of moisture) were used per 100 cc of sea water.

Series No. 1 used Mud sample No. 1 and was kept at ordinary laboratory temperature and were taken from time to time. The results are indicated in the following table.

	Interval in days since series was started.	Parts of ammoniacal nitrogen per 100,000 parts.
Sea Water	. ..	0.01
" " and Mud	0.00	1.37
" " "	1.00	1.5
" " "	4.00	2.54
" " "	7.05	3.07
" " "	10.8	3.69
" " "	14.25	5.13
" " "	17.8	5.74
" " "	40.00	5.99

2996 The mud contained 0.447 per cent. nitrogen and showed that rather more than one-seventh, or 15.21 per cent. of this had been evolved as ammonia.

Series Nos. 2. Same methods and quantities were used as in the case of Series No. 1, except that Sample No. 2 of mud was used, and except that the bottles were kept in an incubator at 80 degrees Fahrenheit.

	Interval in days since series was started.	Parts of ammoniacal nitrogen per 100,000 parts.
Sea Water	....	0.01
Sea Water and Mud	0.00	0.03
" " "	1.00	1.72
" " "	2.00	2.64
" " "	3.00	3.18
" " "	4.00	3.88
" " "	5.2	4.91
" " "	7.0	5.01
Sea Water and Mud	9.0	5.63
" " "	14.0	7.48
" " "	19.3	7.48

The mud contained 0.99 per cent. nitrogen, so that rather more than one-seventh or 14.8 per cent. of this was evolved as ammonia.

Q. What were the results of these?

A. The results of these two experiments on the destruction of nitrates and the evolution of ammonia by foul muds are corroborative and indicate the important result that the existence of foul mud in the presence of a sewage-contaminated water has the tendency to cause a retrograde action in the progress of sewage decomposition and to undo a portion of the results accomplished by the superincumbent harbor waters. That is, that the foul muds at the bottom of a harbor or estuary produce a material effect in denitrifying nitrates and sending them back to their former form of ammonia, thus necessitating this nitrification to be accomplished again.

2997

Adjourned to September 11, 1912 at 10:30.

Supreme Court of the United States, October Term, 1911.

THE PEOPLE OF THE STATE OF NEW YORK, Complainants,
against
STATE OF NEW JERSEY and PASSAIC VALLEY SEWERAGE COMMISSIONERS, Defendants.

CORPORATION COUNSEL'S OFFICE,
NEW YORK CITY, Sept. 11, 1912—10:30 o'clock a. m.

Before James D. Maher, Esq., Commissioner.

Appearances:

Dr. William J. O'Sullivan, Special Counsel for the People of the State of New York, Complainants.

Adrian Riker, Esq., of Counsel for the Passaic Valley Sewerage Commissioners, Defendants.

Met pursuant to adjournment.

OLIN H. LANDRETH a witness called on behalf of Complainants recalled for further examination, testified as follows:

Direct examination by Mr. O'Sullivan (resumed):

Q. Professor Landreth, you gave some testimony yesterday in relation to the transmission of infection through flies, in relation to work done by Dr. D. D. Jackson. Who is Dr. D. D. Jackson?

2998

A. Dr. Jackson is a sanitary expert who has been employed by the Water Department of the City of New York a number of years.

Q. And his official position is that of director of the Mt. Prospect Laboratories

A. Yes, sir.

Q. Did you have any relationship of any kind to the investigations at any stage made by Dr. Jackson, to which you alluded in your testimony yesterday?

A. No official relations. I was frequently consulted by the members of the Merchants' Association Committee at the time the Committee contemplated the undertaking of this line of inquiry as to the general field of inquiry and more particularly as to the recommendation of men to be engaged to conduct the investigation, and at frequent intervals during the progress of the work, matters were discussed with me by members of the Committee.

Q. So that you were aware, were you of the line of investigation that was to be conducted?

A. Yes, sir.

Q. And of the results of that investigation?

A. Yes, sir.

Q. Professor Landreth, from your personal knowledge as a sanitary engineer of New York Harbor and its adjacent waters acquired during the 10 years in which you were consulting engineer of the New York State Department of Health, and while you were a member of the New York Bay Pollution Commission, and also while you were a member of the Metropolitan Sewerage Commission perior to 1908, including your knowledge of the methods, observations and results of the various studies and investigations which were made by these commissions, and also by the Metropolitan Sewerage Commission of New York subsequent to January 1908, into the physical characteristics and configurations of the harbor and of the harbor inlets, the phenomena of tidal currents and volumes, the presence, accumulation, and character of the foul deposits on the bottom of the harbor and on the shores, the chemical and bacteriological examinations of the waters;—what in your opinion now is, and what will ultimately be, the final disposition of the sewage matters which now are, and which may in the future, be discharged into the harbor waters?

2999 Mr. Riker: The question is objected to for the reason that it does not state the facts upon which this witness is asked to give his opinion as an expert in such manner that they can either be determined by counsel or the court to be or not to be facts shown in the case.

The Commissioner: Note the objection of Counsel for Defendants.

A. In answering this question, a clear distinction must be made between the sewage matters which are in solution or in microscopic comminution on the one hand and those in suspension on the other. The portion of the sewage which is in solution is diluted more or less unevenly with the waters into which it is discharged and gradually but slowly suffers decomposition by the bacteria of the harbor waters. Where the proportion of the volume of the diluting harbor water to the volume of the dissolved sewage matters is adequate, and the water carries sufficient oxygen, the decomposition will be accomplished under aerobic conditions and no objectionable odors nor deposits will result. Where, however, the diluting water is inadequate or where the distribution of sewage is so concentrated that in localities the oxygen of the waters is either exhausted or seriously reduced, then the decomposition of the organic matter in solution

is accomplished under anaerobic conditions and offensive odors are certain to follow. With the sewage solids, however, a different condition exists and different results follow: all or all except a very small portion of the sewage solids now discharged into the harbor waters are deposited within the harbor limits. Only a small portion floats out to sea and a considerable portion of that which does returns on the next incoming tide, owing largely to the configuration of the shore lines outside the harbor limits both at the Narrows and at Sandy Hook and Coney Island for the inlet at the Narrows and the shore lines of Long Island Sound for the East River inlet. These sewage solids thus confined within the harbor limits are soon deposited on the bottom at so early a stage that a comparatively small portion of the decomposition of the solids is accomplished while they are in suspension; much the larger portion undergoes decomposition after being deposited on the harbor bottom: Since aerobic bacteria can only gain access to the immediate outer surface of the solids even when in suspension and when deposited on the bottom, the aerobes are virtually prohibited from operation.
3000 The internal mass of the suspended solids and also of the deposited solids or sludge is all exposed to anaerobic conditions and anaerobic decomposition follows, with the resulting liquefaction and gasification of the solid matter. When these liquid and gaseous products are liberated and commingled with the over-lying harbor waters they are rapidly oxidized by the dissolved oxygen of the waters thus robbing the waters of their capacity to sustain aerobic life and to oxidize organic matter in solution, and the unabsorbed gases escape into the atmosphere and give rise to effluvium nuisdnces.

If this production and liberation of the liquefied and gasified portions of the sludge were produced uniformly the year round the results would be less harmful than is the actual case. The activity of the bacterial decomposition and the liberation of gases is strongly dependent on the temperature of the waters. During low temperatures the activity is slight and the liberation of liquid and gaseous matter from the sludge on the bottom is at a minimum, but when the high temperature of the summer months occurs, then not only is the rate of liquefaction and gasifaction greatly increased, but also the liberation of the liquid and gaseous material is still further enormously augmented by the disturbing and erruptive influence of escaping gas, which tends to tear loose from the bottom and to float up through the water particles of previously deposited sludge, by this means not only aiding in the commingling of the liquid and gaseous products of decomposition with the overlying harbor waters, but rendering the water turbid by commingling the sludge thus brought up from the bottom. This class of operations will continue when the amount of sewage is increased. The principal difference will be in the intensity of the objectionable conditions, which will certainly arrive when the quantity of sewage is brought farther down and discharged into the lower waters of the harbor when it shall be so increased, that the localities, which are now widely scat-

tered, wherein obnoxious conditions exist, shall in future become more extensive, and ultimately cover much larger portions of the entire harbor. We have those extremely offensive localities
3001 now. The future will tend to increase the area of these localities and increase the number and ultimately to cause them to become the prevailing condition of the harbor. In relation to that influence, there also comes the future effect of the proposed discharge of sewage from the Passaic Valley trunk sewer. Whereas the sewage deposition takes place in the Passaic River now, and in the upper portion of Newark Bay and in lesser portions in the lower part of Newark Bay, thus making the river and the bay a natural disposal plant, in the future when the sewage has been removed from the river and brought down through the tunnel and discharged into the bay, there will be a sudden disturbance and alteration of conditions, not gradual, but sudden, transposing the place of disposal from the Passaic River to the middle of New York Bay or lower portion of the upper Bay. That sudden change is entirely distinct from the gradual change which will occur due solely to the increase in the quantity of sewage, which the future will bring about. I hardly need draw the parallel between that prediction and what has actually occurred in the case of Belfast lough, which I have referred to on one or two occasions in my testimony before. Just the same conditions are proposed here that existed there, and there is no reason to believe that other results will follow. Even if we did not have the benefit of that example before us, it is difficult to escape the conclusion that whereas now the Passaic River and the upper portion of Newark Bay produce the deposition of sludge on the bottom, and the sludge nuisance and effluvium nuisances are confined to this territory, in future they will be transferred to the State of New York, in the lower portion of New York Bay.

Q. Professor Landreth, do you know of any condition of effluvium nuisance on the New Jersey riparian shore that has been complained of?

Mr. Riker: The question is objected to on the ground that it is incompetent and irrelevant.

The Commissioner: Note the objection of Counsel for Defendants.

A. Yes, sir. I know of a good many instances where complaints have been made of effluvium nuisances along the shores of the
3002 Passaic River and Newark Bay, and in fact even on the Jersey shore of the North River.

Q. How bad were these effluvium nuisances complained of, on the Jersey shore, near the North River?

A. The complaints were couched in very severe terms and characterised the nuisances as being unbearable, rendering it in one instance unbearable as claimed by the Complainants, and I myself have frequently examined the various slips on the Jersey side of the river, Hoboken and to some extent at Weehawken, but more especially at Hoboken and Jersey City.

Q. Are you at all familiar with the Bronx Valley trunk sewer

conditions, and if so, state what knowledge you have in relation to that project?

A. I am somewhat familiar with that project. At the time that the bill was introduced into the New York legislature providing for the establishment of the Bronx Valley Sewer Commission in the first instance, I drew the attention of the State Commissioner of Health to the bill and directed his particular attention to the fact that it removed from the State Commissioner of Health the right which heretofore existed——

Mr. Riker: Do you think by any possibility that this is competent evidence in this case?

Mr. O'Sullivan: I certainly do, Mr. Riker, for this reason——

Mr. Riker: Are you going to let this witness go on with his lecture? It has no bearing on this hearing as far as I can see. What difference does it make what he heard in regard to what was going to happen? The question is as to the facts.

Mr. O'Sullivan: He will give you those facts and I consider it very material and relative evidence because there has not been an expert offered by the Complainants, who has not been questioned on the Bronx Valley Sewer. We are now going to give you testimony to show that he has had direct connection with it.

Mr. Riker: Let him give his facts.

Q. Proceed, Professor.

A. I drew the attention of the Commissioner of Health to the fact that the bill as proposed removed from that officer, the
3003 right to pass on and approve the plans for the sewer construction.

Mr. Riker: I move that that testimony be stricken out as incompetent, irrelevant and hearsay.

The Commissioner: Note the motion of Counsel for Defendants.

A. (Continuing:) Thereupon the State Commissioner of Health had an interview with the representatives in the assembly and they declined to advance the bill unless the promoters would modify the bill so as to retain in the power of the State Commissioner of Health the right of approval.

Mr. Riker: I move that that be stricken out as clearly hearsay.

The Commissioner: Note the motion of Counsel for Defendants.

Q. In what capacity did you interest yourself in the matter that you have just now described?

Mr. Riker: The question is objected to as immaterial, incompetent and irrelevant.

The Commissioner: Note the objection of Counsel for Defendants.

A. I was at that time Consulting Engineer of the Department of Health.

Q. In the State of New York?

A. State of New York and it was my duty to keep watch of legis-

lation which affected either injuriously or beneficially the sanitary interests of the State.

Q. In the discharge of that duty did you interest yourself in the manner just described in your testimony now?

A. I did.

Mr. Riker: The same objection.

The Commissioner: Note the objection of Counsel for defendants.

Q. You may proceed, Professor?

A. The bill as passed contained the modification which left in the hands of the State Commissioner of Health the right to approve or disapprove of the sewer plans.

Mr. Riker: I shall move to strike this testimony out as it is attempted by this witness to give the legal effect of a bill of the Legislature of the State of New York, which testimony, if competent, at all, must be by the production of the bill itself.

Mr. O'Sullivan: The bill is already in evidence, I wish to advise Counsel for Defendants. It is part of one of the exhibits

3004 in evidence in this case.

The Commissioner: Note the objection of Counsel for Defendants.

A. The bill also gave the State Engineer the power of approval.

Mr. Riker: I shall move to strike out that testimony on the same ground.

The Commissioner: Note the motion of Counsel for Defendants.

Q. Proceed.

A. Requiring that the plans before construction should meet the approval of both officers, not only the State Commissioner of Health, but also the State Engineer.

Mr. Riker: I shall move that that testimony be stricken out on the same ground.

The Commissioner: Note the motion of Counsel for Defendants.

Q. Proceed.

A. Subsequently when plans were prepared by the Bronx Valley Sewer Commission and submitted to the two officers conjointly for their separate approval, it was found that the plans did not provide for adequate treatment of the sewage.

Mr. Riker: I shall move to strike that testimony out as not being responsive to any question, and being hearsay only.

The Commissioner: Note the motion of Counsel for Defendants.

Q. Did you examine those plans yourself?

A. I did, and as a member of the Metropolitan Sewerage Commission of New York, of which Commission I was at that time also a member, I appeared before the State Engineer and State Commissioner of Health in opposition to the approval of the plans which did not contain adequate provision for the treatment of the sewage.

The plans, with some modifications, and after considerable delay were finally approved, and I subsequently, as a member of the Metropolitan Sewerage Commission, and as a member of the committee appointed by that Commission to confer with the Bronx Valley Commission officials, I appeared before those officials and endeavored to have the plans still further modified so as to adequately provide for the disposal of sewage. Since that time I have had no official
3005 connection with the question, but I have kept in close touch with the progress of the Bronx Valley Commission and insofar as I have been able, I have endeavored to prevent the construction of the Bronx Valley sewer and outfall without an adequate provision for the treatment of sewage.

Mr. Riker: I move to strike that testimony out as incompetent and irrelevant, it being of no possible importance what this witness has attempted to do.

The Commissioner: Note the motion of Counsel for Defendants.

Q. Professor Landreth was the Bronx Valley trunk sewer finally constructed?

A. It was.

Q. Has it ever been operated?

A. To a very slight extent and for comparatively a short interval of time.

Q. What occurred that interfered with this operation?

A. The use of the sewer was enjoined by the courts of the State of New York, except so far as relates to one municipality using that sewer, which municipality had already previously constructed a sewage disposal plant, and the use of the sewer by that municipality was permitted solely on condition that the municipality should resume the use of its disposal plant and turn the effluent so treated into the sewer and no untreated sewage.

Q. Did the Federal authorities interfere with its operation?

A. They did.

Q. State how?

A. By a suit in equity as I recall, to restrain the Bronx Valley Sewer Commission from using the sewer until it should satisfy the court that adequate provision for the treatment of the sewage was being installed and used.

Q. What was the outcome of that suit?

A. The outcome of that suit was an agreement reached between the United States, Complainants and the Bronx Valley Sewer Commission, Defendants, by which in July of the present year articles of agreement were entered into and that agreement is now in force.

Q. What does that stipulation between the Federal Government and the State of New York or the Bronx Valley Sewerage Com-
3006 missioners require in regard to the disposition of the sewage proposed to be discharged through the Bronx Valley trunk sewer.

Mr. Riker: The question is objected to on the ground that if this matter is material it should be proved by proving the agreement itself and not by this witness.

The Commissioner: Note the objection for Defendants.

A. The agreement provides a series of results which shall be accomplished. Those results are substantially the same as the results which were included in the agreement already in operation between the United States, Complainants and the State of New Jersey, Defendants, in the Matter of the Passaic Valley Sewer, with two important additions. The first of these additions is that a definite degree of purification results must at least be obtained by fairly definite plans. The second difference is one which permits a future increase in the degree of purification demanded, by which the Government on or after the year 1917, may review the then existing conditions, through a Board of experts, designated in accordance with the terms of the agreement, and the findings of that body shall be communicated to the Secretary of War. The Secretary of War thereafter shall have the right, under the terms of the agreement to require that the Bronx Valley Sewer Commission shall increase its means for purification above those stipulated in the first portion in the agreement, and it further provides that the Secretary of War shall at all times have reasonable opportunity for determining whether the terms of the agreement are being carried out or not. The agreement at large in general contains two features which are decidedly in advance of the agreement already existing between the United States and the State of New Jersey, concerning th Passaic Valley sewer. With respect to the two clauses I have just mentioned.

Q. Mr. Riker in his objection, Professor Landreth, demands that the stipulation itself be offered in evidence,—have you got a copy of that stipulation?

A. I have.

3007 Q. Will you produce it?

(Witness produces copy of stipulation.)

Q. Where did you get this copy of stipulation?

A. I cannot say definitely, but I either obtained it from Special Deputy Attorney General representing the United States or through one of the officials of the Merchants Association Committee. I think that I got it through the United States Attorney.

Mr. O'Sullivan: I offer the paper produced by this witness, purporting to be a copy of a stipulation entered into by and between the United States of America and the People of the State of New York, and John E. Andrews, William Archer and John J. Brown, Commissioners of the Bronx Valley Sewer, executed on the 17th day of July 1912, and in offering this in evidence and asking that it be marked Complainants' Exhibit No. 177 in evidence in this case, I wish to do so with the reservation that I will substitute a certified copy of the original stipulation when it is filed in Washington. I also wish to state that I have made application to the Clerk of the Supreme Court of the United States for a copy of this stipulation, and that it is not as yet on file and I have been promised a certified copy as soon as the stipulation is filed.

Mr. Riker: The offer is objected to on the ground that the paper

is not authenticated in the way that it should be, in a way to make it competent in any case, and that it is incompetent, irrelevant and immaterial in any event.

The Commissioner: Note the objection of Counsel for the Defendants.

Received and marked Complainants' Exhibit No. 177.

Marked Complainants' Exhibit No. 177.

Q. Professor Landreth, I hand you Complainants' Exhibit No. 135, and ask if you have studied the guaranteed form of effluent as set forth in that stipulation between the Federal Government and the State of New Jersey?

A. I have.

Q. Comparing Complainants' Exhibit No. 135 which is the stipulation in the Passaic Valley Trunk Sewer project, and Com-
3008 plainants' Exhibit No. 177, which is the stipulation in the Bronx Valley Sewer outlet, how do they compare as to the requirements for sewage purification demanded of the respective commissioners?

Mr. Riker: The question is objected to on the ground that there is no instrument legally in evidence represented by the number 177 and that therefore the comparison is irrelevant, immaterial and incompetent.

The Commissioner: Note the objection of Counsel for Defendants.

A. The comparison of the two agreements indicates that for the present and up to the year 1917, the requirements demanded of the Bronx Valley Sewer Commission are substantially the same as those demanded of the Passaic Valley Sewerage Commission in the discharge of their respective sewages, but even for the ensuing five years from now to 1917, a much more definite manner of determining whether those conditions are being accomplished is provided in the case of the Bronx Valley Sewer Commission agreement, than in the case of the Passaic Valley agreement, and thereafter, after the year 1917, the agreement with the Bronx Valley Commission explicitly gives the Government the right to modify and to increase if necessary the requirements stipulated for the present time. In just so far as those requirements are increased in just that far will the results accomplished by the Bronx Valley agreement be superior to those accomplished by the Passaic Valley agreement. And even during that time a much more definite manner of ascertainment or verification of the accomplishment of results is provided, so that in both those respects I consider the Bronx Valley agreement to be superior to the Passaic Valley agreement.

Q. Directing your attention again, Professor Landreth, to Complainants' Exhibit No. 135, I ask you if the results guaranteed in that stipulation are feasible to obtain from the methods described in the fore part of the stipulation itself?

A. I doubt somewhat if they can be obtained, even if they could be ascertained. Even if the exact result could be identified and determined. But the more serious defect of the Passaic Valley agree-

ment to my mind, is the difficulty of determining when and
3009 when not the results are obtained and the omission of any definite and explicit manner of identifying the accomplishment, and of making it capable of ascertainment, is in my mind a striking defect of the Passaic Valley agreement.

Q. Now, Professor Landreth, will you assume that the facts and data have been proven as set forth in Complainants' Exhibits from Numbers 1 to 158 inclusive; assume that these exhibits from Numbers 1 to 158 inclusive, set forth correctly the observations, statistics, chemical analyses, bacterial determinations; photographic reproductions of places and things observed; charts and maps of contours of surface and sub-surface localities; apparatus employed, together with the reports made thereon by the observers, and now in evidence in this case, have been proven. Assume, also that the tabulations of oxygen determinations, the tabulations of bacterial count; the tables of averages for oxygen determinations, bacterial count and harbor deposits; the charts plotting float observations, oxygen percentages, bacterial count, and mud examinations; the current observations, report of tidal actions; and graphic charts thereof; current velocities, indices of sample stations and plottings thereof; microscopic examinations of harbor deposits, photographs and charts of sewage fields, dispersion areas, and sleek fields; all as set forth in Complainants' Exhibits from Numbers 1 to 158, inclusive, and such other scientific data as are included in these exhibits are proven.

Assume, also, that the testimony which you have reviewed and which has been given by witnesses preceding you in the hearings in the present suit between the State of New York and the State of New Jersey, on all these enumerated matters, and also on the precipitation; run-off; present and prospective populations of the drainage areas, and such other scientific data as has been included in the testimony given thereon, have proven the matters therein testified to—

Taking all these facts and circumstances of record in this case, and facts observed by you, and to which you have testified into your full consideration, what, in your opinion, will be the results of the con-
templated discharge from the Passaic Valley Trunk Sewer out-
3010 let into New York Upper Bay, in the vicinity of Robbins Reef, on the Harbor Waters and tidal waters of New York Harbor, under present existing conditions and under prospective conditions, on or about the year 1940, and during the intervening period between the present year 1912 and the year 1940?

Mr. Riker: The question is objected to for the reasons given on the propounding of the same question to the last preceding witness to whom it was directed.

The Commissioner: Note the objection of Counsel for Defendants.

A. In my opinion I believe that a number of harmful results will follow. In the first place, and perhaps least serious of all, the artistic beauty of the waters of New York Harbor, which is the gate-

way of immigration and of a large portion of foreign travel to this continent, will be seriously impaired. Every incoming and outgoing steamship will pass through this sewage field, which will be produced. Will pass through the disposal area which is proposed to be used by the Passaic Valley Sewer Commission. And on that point alone of the beauty of the waters, they are of value not only to the foreign travel and coastwise travel, but largely, and perhaps in greater degree to the residential population. The water ways and water parks of New York constitute one of its most valuable assets. The City would be entirely unable to supply in the way of parks or artificial provisions, anything approaching the beauty of the New York waters which surround the Island, and in which, of course, New Jersey is a partner. The water ways so far from being an obstacle to interfere with communication, they should be a great help to inter-communication, and inter-communication not only for business purposes, but also for recreation purposes. A large proportion of the population of the business men doing business in the City of New York live outside. A considerable portion pass across the waters every day. Another large portion visit those waters for recreation purposes, and I consider it to be of the utmost importance that, entirely apart from sanitary and other considerations, those waters should be kept beautiful just as I consider that every park should be kept clean and carefully policed, and
3011 provided with features which shall tend to elevate the tone of human thought and aspiration and tendency. So I think the waters which constitute a park in themselves, a series of water parks, should also be kept clean and in that regard I am not drawing any state lines. I think New York should be held just as strictly to cleanness as New Jersey. I think my attitude in the various matters in which New York questions have been concerned, show that I have been sincere on that point, and that it indicates my real belief. I am not a partisan on that point.

Next, next to the matter of the appearance of the waters comes the question of odors. The point of the discharge of the Passaic Valley Sewer is just such a place as that there will be several miles of swing for the tide on the ebb and flood before the sewage discharge can disperse laterally. It is confined to a fairly narrow channel and whether it is on the ebb or on the flood, it is confined to an area so small, that in my belief odors at many times, especially during warm temperatures, will be given off from the sewage. Some from the fresh sewage, but most of all from the septic or stale sewage, or the sewage sludge rather, which rests on the bottom. Not only will the odors come from the waters, but from the shores which are exposed during low tide. The range of tide is about four feet on the average and 4 feet of vertical difference of level of the waters uncover many many square feet of area of shore territory, and since those shore areas or zones will receive their quota of deposits, it follows that those deposits will be uncovered at low tide.

Next in order I mention the reduction of oxygen in harbor waters. The reduction of the oxygen content in the waters. It is already impaired and is being impaired progressively, and it will

still further be suddenly impaired to a great extent when this sewer begins to be operated, by reason of the difference in the place of disposal of the sewage, from the Passaic River to New York Bay. The
3012 reduction of the oxygen will have a serious effect in several ways. In the first instance it will injuriously impair the capacity of the waters to dispose of industrial organic matter, in an aerobic and harmless condition. In just so far as the waters can treat the organic matter in an aerobic condition, the results are comparatively, as compared to the anaerobic conditions, comparatively harmless. The measure with which waters may do that depends largely, if not essentially on their content of oxygen on the percentage of saturation of oxygen, which the waters carry. The discharge of this sewage at this point, stale sewage, sewage which has been a number of hours of age when it reaches the disposal area will very rapidly decrease the amount of available oxygen by the oxidation of the septic and stale sewage thus discharged at this point. The reduction of the oxygen also will do harm to animal life. Animal life of almost every grade from the line of demarcation with the vegetable up to the grosser forms of visible fish life are dependent for oxygen on the supply which they receive from the waters. If this supply is impaired, the animal life is disturbed and the balance between the animal life and vegetable life is disturbed and that balance in any waters constitutes an important safeguard to the permanency and stability of those waters. If we in any way disturb one we disturb the other, and in a harmful manner.

Not only will the oxygen be reduced, but the turbidity will be increased. The water will be less clear, less sparkling than at present. It will be less transparent, and the result of that will not only be of an esthetic nature, but also of a biological nature. The life in the water is affected by the light which enters it in a very sensitive degree. If the water is made turbid then the sunlight cannot enter, or it enters to a lesser extent, and the increased discharge of sewage at the lower portion of New York Bay will tend, in the manner which I have already explained this morning to increase very materially the turbidity of those waters, and thus deprive the waters of sunlight as well as to impair their esthetic appearance and their clarity.

Another result which will flow from the construction and discharge from this sewer, will be the impairment of the bath-
3013 ing beaches and bathing houses. They are already on the verge of danger. They are already in some cases unfit to use even at present. This result will still further increase that danger. So far from preventing harmful conditions and rectifying them as we are endeavoring to do, this will give a decided impetus to further detriment and the further impairment of the waters, rendering the bathing beaches and bathing houses even less safe than they are at present.

I have mentioned already the element of the impairment of the oxygen as affecting animal life. A portion of that animal life will be of industrial value. That is the fish life, and to some extent

also shell fish life, and the impairment of the oxygen will in addition to making the water foul tend to drive away fish life from the waters. It will also have a very direct and harmful influence on the shell fish life, not only by impairing the conditions under which that life grows, exists, but also rendering the use of shell fish taken from waters so polluted, still more dangerous than they are at present. So far from decreasing our shell fish fields we should endeavor to increase them. Our population are dependent to an appreciable degree on the fish life and shell fish life and the freshness of that supply of food and the cheapness of it depends on the extent of the fields for oyster and other shell fish lanes, and those fields should be protected and improved, and not impaired. Those I consider to be the more important of the results which will follow from the construction and use of that sewer.

Q. Professor Landreth this teeming minute vegetable and animal life that you have described in your answer to my last question, does it play any important function in the purifying agencies in relation to this organic matter in sewage?

A. Oh, yes, especially the vegetable life does, and the vegetable life constitutes the food for the animal life, so that both are seriously directly influenced by anything which impairs the living conditions of the vegetable life. The vegetable life in water includes the bacteria which are the agency by which the sewage in solution, and in part the minute, comminuted sewage in suspension, are
3014 reduced, and if we impair the growth of that life by robbing it of its oxygen, we are, as I have said before, decidedly impairing our purifying mechanism of the harbor, so that the harbor will be less able to handle a given amount of sewage than it is even at present.

Q. You mentioned sunlight in your answer, Professor Landreth. Does that influence in any particular these purifying agencies that are included in the term "plankton"?

A. It does, in a very influential manner. Perhaps no other agency except temperature is there that has a greater influence on the nature of the activity of water life than sunlight.

Q. In discussing in your answer the water parks and their esthetic importance, did you regard any relationship between environment and citizenship?

Mr. Riker: The question is objected to as immaterial and irrelevant.

The Commissioner: Note the objection of Counsel for Defendants.

A. I do and a very striking relation, an underlying fundamental relation.

Q. What would be the condition of the sewage in your opinion discharged at the outfall of the Passaic Valley trunk sewer as contemplated as to its age?

A. It would be what sanitary engineers would call stale sewage. The time required for sewage to pass from the average center of gravity of the population to the point of disposal will be so long that the sewage will be well advanced in decomposition, and that

decomposition will be of necessity of the anærobic or septic kind, rather than the aerobic. The supply of oxygen in the sewage itself will be very soon exhausted, and from that point, in time and in place, down to the outlet the sewage will be exposed to anærobic and therefore septic or putrefactive decomposition, so that the discharge of sewage will be the discharge not of fresh sewage, nor of sewage which has been furnished with plenty of oxygen by which to have undergone aerobic reduction, but septic sewage which has been deprived of its oxygen, which has therefore undergone septic decomposition.

3015 Q. You have used the terms Professor Landreth "fresh sewage" "stale sewage" and "septic or putrid sewage". Will you define what you mean by these terms when you employ them?

A. By "fresh sewage," I mean sewage which has been so recently produced or discharged as not to have progressed to any appreciable extent along the line of decomposition. Certainly not to have progressed along the line of anærobic or putrefactive decomposition. On the contrary, sewage which has progressed along that line, by reason of the absorption, the consumption of all its oxygen, that sewage I call "stale" or "septic sewage."

Q. Does stale sewage readily become septic?

A. Yes, stale sewage is almost of necessity septic, but if not, it will very rapidly become so, because of the setting up of conditions favorable to anærobic decomposition.

Q. How many years have you been studying the problem of the digestive capacity of our harbor waters in one official capacity or another?

A. Well, since the first time since I commenced my study of the harbor waters—I have spent about 16 years although I do not wish to be understood as saying that I spent 16 years in studying. I have not given the whole of my time to that matter by any means, but I commenced by knowledge of New York harbor conditions in the year 1896, at which time I was appointed Consulting Engineer of the State Board of Health, and I very frequently had conditions requiring my attention, which involved conditions in and about New York harbor and adjacent waters, and that has been kept up with greater or less frequency ever since. During the years from 1903 to 1908, however, I gave more time to the matter than I did for the years before that.

Mr. O'Sullivan: Your witness, Mr. Riker.

Cross-examination by Mr. Riker:

Q. In your direct examination you have detailed certain experiments, the results of certain experiments with mud upon water. Did you make any of those experiments yourself?

3016 A. None of those which I detailed. I made experiments on some others.

Q. I did not ask you that. Will you answer my question please. Did you make any of those that you have detailed yourself?

A. I did not.

Q. Were you present when they were made?
A. I was not.
Q. Where did you get them from?
A. I learned of those which I quoted from the British Report by a study of the reports of the Royal Commission on Sewage Disposal of England, and by a study of the reports of the preceding Commission on River Pollution.
Q. You got them from the reports, did you?
A. In the main, yes, sir.
Q. That is the only way you got them?
A. And from collateral literature.
Q. The ones that you have detailed here, did you get them from the collateral literature or did you get them from the reports?
A. The matter which I have reported here came entirely from the reports.
Q. Now, in your testimony as to the effect of muds upon the harbor waters of the various cities in this country and in Europe, is there any one case that you know of where the sewage was subjected to any kind of treatment before it discharged into the harbor waters?
A. Yes.
Q. Which one?
A. Belfast.
Q. What kind of treatment?
A. Screening.
Q. What kind of screening?
A. Screening through—I cannot give you the size of the screens.
Q. That is important, is it not?
A. I do not think it is especially important, no.
Q. You do not think so?
A. Not with the sewage of the age of the Passaic Valley sewage.
Q. I am not asking you about the age of the Passaic Valley sewage. I am asking you about the treatment of the Belfast sewage. You say it is of no importance what the size of the screen is?
A. In the case of the Belfast sewage it is not of very much importance.
Q. Very well. What other city in this country or in Europe as to which you have testified with reference to the effect of
3017 mud on the harbor waters is there any treatment of the sewage before it is discharged into the harbor?
A. I do not now recall any. I have not given especial attention to that, because I do not think it of any especial importance.
Q. I am not asking you whether you consider it of special importance, do you know of any?
A. I do not.
Q. Is the question of the pollution of New York Harbor by muds of any importance with reference to the water supply of the City of New York?
A. I do not think it is.
Q. So that the cities whose water supplies have been injuriously

affected by the muds are not of any importance as parallels to the conditions in New York Harbor?

A. I think they are very strongly parallel.

Q. With reference to the water supply they are strongly parallel?

A. With reference to the water supply they are not parallel. In all other respects they are parallel.

Q. What is the element in the deposit of mud in the harbor, which in your opinion is injurious?

A. The element in the deposit of mud is not harmful unless it reaches the point where it interferes with navigation, but it is the subsequent decomposition of that mud that constitutes the real serious harm.

Q. What is the element in the mud which is subject to decomposition, which produces the serious harm?

A. The organic matter. When I speak of mud, I am speaking of sewage mud, I am not speaking of mineral silt.

Q. The muds which have come under your observation in connection with this suit, have they consisted exclusively of deposits from the sewage?

A. No, they are a mixture of sewage and mineral silt.

Q. And which is the element which is injurious in your opinion?

A. The organic solids from the sewage are the ones which are injurious from a sanitary standpoint. From the standpoint of the use of the waters of the harbor the silts are also injurious so far as they tend to shoal the water, rendering the diluting volume less and perhaps by impairing the navigation depths.

3018 Q. Well, what are the injurious results which you have observed from the deposition in harbor waters of muds of the varieties which you speak of?

A. The injurious results are that the water is rendered turbid, rendered unsightly by reason of floating matter, rendered obnoxious by reason of the stenches which arise from it.

Q. Anything else?

A. And by reason of the injury to vegetable and also to animal life which exists in it.

Q. Well, is that all?

A. Those are the principal sanitary objections. I have mentioned them more fully already in my direct examination.

Q. Well, now, what injury does turbidity produce?

A. Do you wish me to go over my direct examination?

Q. I wish you would answer my questions. That is all I am asking you to do. If you have got to go over your direct examination I am sorry to say that we shall have to do that. And if you want to consult your written notes, you will have an opportunity of doing that.

A. I will follow along the line of my direct examination.

Q. Answer the questions please?

A. My idea as to turbidity is that it is an injurious element introduced into the water, first from the esthetic, artistic standpoint, in that the water is not only impaired in its clarity and clearness and color as well, so as to be rendered unsightly and turbid, lacking

in clarity, lacking in transparency, lacking in that glistening clearness which comes from sunlight penetrating down into the water. There is nothing that is like it. It is like the reflecton of water from a clear water surface and cannot be compared with the reflection of water from a mirror. The two are entirely distinct, and life of the water depends quite largely, and in saying life, I mean the artistic life, the appearance of the water, it depends quite largely on the clearness with which the light can penetrate down into the water. The next effect is to impair vegetation, the water vegetation. The water flora which are not only the means of purification of the organic matters which reach the water in
3019 a dissolved state and a finely comminuted state, but also constitute the food for the water fauna, the animal life.

So that I count turbidity to be objectionable for both of these reasons.

Q. Now, does turbidity result from the presence in the water of organic polluted matter, or mineral?

A. It does, if that organic polluting matter is in suspension. If it is in solution it does not affect the turbidity, but it does affect the color.

Q. Well, does mineral polluting matter affect color, turbidity, or both?

A. Both.

Q. Both?

A. Yes. Mineral matter being heavier settles much more rapidly.

Q. And the destruction of this vegetable growth in water by turbidity in itself, what injurious effect does that have?

A. I have just explained in answer to the last question that it has an injurious effect of destroying the water flora and thereby robbing the water of its power of self purification. It also removes the animal food and thus disturbs the balance of animal life in the waters by taking away its food. We should not be able to raise cattle unless we could raise grain.

Q. And if there were no sewage poured into the waters, do you think it is important whether or not the vegetable life remains there with the exception of the influence it may have upon the large fishes?

A. Yes, I think the presence of that vegetable life is important, even if every sewer in the cities surrounding were taken out by reason of the fact that in a population as dense as this is, or as dense as any urban population, there is invariably a considerable amount of pollution that reaches the river over the surface by drainage and by being thrown into it, which cannot be prevented. Every rain that washes over the surface brings in a certain amount of organic matter. The purifying capacity of the water vegetation is needed to keep that pure, and even if there were not any sewage at all, the purifying effect of the vegetation of the water, to keep
3020 the water pure from inevitable and offensive and unavoidable pollution that gets there by other means than by sewage. It is needed for that.

Q. And the water that falls and runs off and reaches the waters

of the bay, you do not call that sewage if it does not go through a sewer?

A. Well, I do not call it sewage, but it is harmful just the same, and to some extent it is harmful in the same way.

Q. How does it differ from sewage in what respect?

A. Usually in carrying with it a larger proportion of mineral matter which tends to increase its weight, its sedimentation.

Q. What is the percentage of organic matter which in your judgment constitutes sewage as distinguished from this matter that you say is not sewage.

A. I should not attempt to define sewage by any hard and fast per cent. between those two portions. In the so-called separate system of sewers, a system into which nothing but sewage is discharged the per cent. of mineral matter is one thing, and in a combined sewer system, which drains the surface of the ground of the city, and which brings in the storm water flow over the surface, the per cent. of organic matter is much smaller and even that is widely different, depending on the portion of the city you are considering sewage from.

Q. I am asking you to tell me what percentage of organic matter in your judgment renders it properly designated as sewage?

A. The first part of my answer answers that.

Q. Cannot you answer it?

A. I can, I did.

Q. What amount in percentage?

A. My answer is that there is no definite per cent.

Q. You cannot answer it?

A. I can, and I have answered it.

Q. Very well, that is your answer, you cannot say?

A. I can say,—I have said.

Q. There is no percentage that you know of?

A. I have answered that the percentage is variable depending on first the place and then the kind of sewer you are talking about.

3021 Q. I am not talking about any sewer. I am talking about sewage and I want to know what percentage of organic matter constitutes liquid sewage?

A. I have answered that.

Q. Answer it again please?

A. I will say that unless you distinguish between the products of a sanitary sewer system that receives storm sewage and one that does not, I will not attempt to fix any per cent. If you are asking about a sanitary sewer system which discharges nothing but sewage, then I can give you a close approximation to the per cent if you desire it.

Q. I am asking you without reference to any particular kind of sewer, but with reference to the liquid sewage what percentage of organic matter constitutes that liquid sewage?

A. Your question is too indefinite in the form in which you ask it to admit of an explicit answer.

Q. You cannot answer it in other words?

A. I have answered it.

Q. So that you have no expectation in the operation of your various municipal bodies, to which you belong, and to which membership you have testified, of excluding from New York Harbor the surface waters of the City of New York?

A. By no means. Certainly not.

Q. Do you expect to do that?

A. No idea of doing it.

Q. What?

A. There is no idea of doing it. It may be that the surface water will be purified, but as to the diversion of the surface waters, that is too laughable to talk about.

Q. This surface water you do not call sewage?

A. I do not, although that may carry sewage.

Q. Now, take the sewers as they exist in the City of New York. What is the character of the sewage that they discharge into the waters of the bay?

A. The sewers of the City of New York are in most part of the combined sewer type. That is to say through the main system pipes, there is discharged into the harbor the sewage proper by which I mean the animal and vegetable organic waste plus the industrial waste of human activity, with a large amount of diluting and
3022 transporting water. That I call sewage. That flows day by day whether there is any ground drainage or surface drainage or not. Through those same pipes there is carried in addition to that matter, at the time of storms, large amounts of surface water, which runs over the surface and reaches the gutters and catch basins and enters the sewers and in doing so, it brings to the sewers a large amount of mineral matter, and in certain places considerable portions of organic matter.

Q. Is it properly designated as crude sewage?

A. No, sir.

Q. It is not, why is not it properly designated as crude sewage?

A. Because it is designated by something else, by another term.

Q. In your judgment it is not properly designated by the term "crude"?

A. During a storm,—I am speaking of times of storm now.

Q. I am asking you in regard to the sewage of New York. Is it properly designated by the term "crude" or is it not?

A. Speaking of the sewage that comes out during a storm, or in an interval between storms?

Q. I am asking you the question as it is propounded?

A. All I will say is that during the intervals between storms the discharge is sewage, and it is crude sewage. During storms the sewer is discharging not only sewage but storm water.

Q. What is the percentage of organic matter in the crude sewage as discharged into the sewers of New York, if you can determine?

A. As far as sewage alone goes, it is roughly divided equally between mineral and organic matter.

Mr. Riker: Will you repeat the question.

(The question was repeated by the stenographer.)

A. I will add to that that if by the term "sewage" you refer to the discharge from the sewers during storms, then the answer does not admit of a definite announcement of value, because it is varying at different times and at different sewers, but in any case the mineral matter is largely in excess of the organic matter in most cases at least.

Q. That is your answer, is it?

A. That is my answer.

3023 Q. Where do the sewers of the City of New York discharge with reference to the shore line?

A. Many of them discharge at the bulkhead line; many others, perhaps not a majority, discharge at the pierheads.

Q. Are there no sewers within your knowledge that do not discharge either at the pierhead or at the bulkhead?

A. Yes, some discharge between.

Q. Where?

A. In the case of the dock frontage some discharge partly out to the pierhead. In the cases of sewer outfalls, which are not in the location of docks, some sewer outlets are located between these lines the bulkhead line and the pier line, which in that case are purely geometrical lines, and not built on.

Q. With reference to high and low tide where do they discharge?

A. Usually below low tide.

Q. Do you know of any that discharge above low tide?

A. Yes.

Q. What is the population of the City of New York?

A. I have not taken it yesterday. I do not recall.

Q. You do not remember any population; you cannot approximate it?

A. I would not attempt to give you the residential population, the population living in the City.

Q. You have no idea what the amount is?

A. It is roughly between four and five millions of people.

Q. Where do you expect to find the injurious effect of the deposition of sewage muds with reference to the sewer outlets?

A. That depends very much on the freshness or staleness of the sewage.

Q. What effect has the freshness or staleness of the sewage, upon the condition of the solid matter in the sewage?

A. An effect of age, and travel, which is concurrent with age, is that the sewage is broken up into smaller particles and as such it is slower in deposition, and on that account it will float farther and farther from the point of outlet than otherwise would be the case.

Q. The deposition then will be more widely dispersed than it will be in the case of fresh sewage?

A. It would be, yes.

3024 Q. With reference to the sewers of the City of New York where do you expect to find the deposition of polluted muds?

A. Right in the harbor slips, where they can be dredged out.

Q. Anywhere else?

A. To some extent out in the harbor channels.

Q. What about those sewers which discharge at the pier-heads? Where do you expect to see the deposition of muds?

A. Partially in the channels and partially in the slips on account of the eddies which bring the floating matter into the slips.

Q. How long have you observed the discharge of the sewers of the City of New York into the slips or at the pierheads?

A. Since 1880. Beg pardon—I was not thinking of the last words of your question, the pier heads. I have known since 1895 or 1896, I have known of sewers being discharged at the pier heads.

Mr. Riker: Will you repeat the question, Mr. Stenographer?

(The question was repeated by the stenographer.)

A. Since 1880.

Q. And with reference to the condition of the sewage, this sewage that you have observed, since such length of time, has it been stale or fresh or septic sewage?

A. I should class it as comparatively fresh sewage.

Q. And therefore in accordance with your previous testimony, is or is it not likely to be deposited near the point of discharge or more near to the point of discharge than it would if it were *septic* sewage?

A. More near to the point of discharge, where it can be more readily dredged.

Q. Anid it can be more readily dredged, why?

A. Because the deposit is confined to a smaller area and to a greater depth. It does not require a thin skimming of the bottom in order to remove it.

Q. Have these injurious effects which you have testified to as the result of the deposition of polluted muds in the harbor, been observed by you all along the shore fronts of the City of New York since 1880?

3025 A. I have not seen all parts of the shore since 1880, and I do not wish to be understood as stating that the conditions are objectionable at all points on the shore, but at a great many points on the shore, I have observed that since 1895 and 1900, a very large number of places where the conditions are what I consider objectionable.

Q. You have observed the turbidity to which you testified as one of the results of the deposition of muds on the bottom of the harbor?

A. I believe it to be, yes.

Q. Do you know whether it is or not?

A. Yes, I know it.

Q. Where did you observe this turbidity?

A. Nearly every one of the slips that I ever examined. I guess I have examined all the slips around this front.

Q. Where else?

A. Your question relates to New York Harbor conditions.

Q. So it does?

A. Also in several of the slips along the New Jersey shore of the North River.

Q. I asked you about the New York Sewage, but if you want to put in New Jersey, why put it in. Where else?

A. I have said at all points. I cannot do any more than that.

Q. What about the sewers that discharge at pierheads, have you observed the turbidity there?

A. Yes.

Q. What ones?

A. At all of the pierheads nearly where sewage is discharged. The turbidity in that case is not so marked at the pierhead as in other cases at the bulkhead line, but the turbidity in the slip is not very materially different.

Q. How far out into the stream beyond the pier head have you observed the turbidity to show?

A. That is a graded distance. The turbidity itself is a graded matter. It varies between all ranges, zero and a very high percentage, so that I cannot fix a definite line to which I shall say turbidity is evident and where it is not. The farther you go from the shore line or the pier head lines, the less is the turbidity.

3026 Q. The turbidity is determined by the sense of sight, is it not?

A. It is quantitatively determined by observation which depends on the sense of sight.

Q. If you do not see any evidence of it, would you say there is turbidity?

A. If you look for it and consider the water with respect to its turbidity, and if you do not see any, then, if you are a good observer, it is a fair conclusion that the turbidity is low.

Q. How far from the pierheads have you observed turbidity?

A. Some turbidity all the way across the river at nearly all stages. There is some turbidity at all stages of the tide.

Q. Due to what in your opinion?

A. Due to the organic and mineral matter in the water.

Q. Which?

A. Both.

Q. Which in your judgment contributes most of the turbidity, the organic or the mineral matter?

A. During storm and following freshets and following high water in the Hudson, the mineral matter contributes most. During other periods of the year the organic matter.

Q. When are those other periods of the year that you refer to when the river is not affected by the storms?

A. They do not go by the calendar; they follow storms.

Q. What proportion of the year in your judgment is it that the turbidity from mineral pollution is not the more prevalent one in the waters of the Hudson River?

A. The month of June, July, August and usually September.

Q. We are now speaking of the whole body of the river?

A. Yes, in general.

Q. One of the other injurious results of the deposits of muds, pol-

luted organic matter, as I remember, according to your testimony, is the effluvia. Does that mean anything more than stench?

A. No.

Q. Well, have you observed that stench along the shores of New York City?

A. Yes, in varying degrees. My term admits of a more
3027 natural grading than the term "stench" does. The term "stench" is usually reserved for a severe form of effluvium nuisance.

Q. In your judgment does effluvium niusance, which does not attain to the degree of stench, constitute a nuisance?

A. Yes.

Q. In what way?

A. By being obnoxious to the public, the people who are forced to come within its influence.

Q. Well, you have observed them along the waters of the City of New York, effluvia of the character which you have described, arising, in your opinion from the mud deposited by the sewage matter discharged from the shores of the City of New York?

A. Yes.

Q. Where have you observed it?

A. At a good many of the slips.

Q. Name some?

A. The basin at Pier 1, in the ferry slips at Liberty Street; the ferry slip at Chambers Street, the ferry slip at Desbrosses Street, the ferry slip at Pier 32, the ferry slips of the Cunard and other steamship lines. At the 59th Street pier, at the Chelsea dock, at 129th Street. In less amount as you go north along the North River, and again on the East River, beginning at South Ferry, rather at the Battery, which is not very bad, because of the circulation there. Beginning around in the slips at South Ferry, coming up to Coentes Slip; Wall Street, Fulton Street, foot of Brooklyn Bridge, at 24th Street, 34th Street, and other piers which I cannot now definitely give you the numbers of farther up, and similarly on the Brooklyn side.

Q. How many years have you observed this condition of stench?

A. I cannot say since how many years it has attained a degree to call stench, but I have observed the evolution of bad odors, effluvia, certainly since 1895, but in increasing amounts and in increasing frequency.

Q. Now, what is the character of this effluvium, or these effluvia that you have observed. Can you detect the different kinds so as to be able to describe and designate them in any way?

A. Well, the prevailing smell is that of stale sewage, in which the odor of sulphuretted hydrogen is one of the strong odors. At
some of the large sewers the odor of fresh sewage, which is
3028 quite a different thing, is also evident.

Q. You can distinguish, and you have distinguished, have you, the odor of sulphuretted hydrogen along the shore fronts as distinguished from that of fresh sewage?

A. At certain places, yes.

Q. Where?
A. In some of the worst of those slips which I mentioned.
Q. Name one where you can say that you have observed it and noted it?
A. Well at the 34th Street ferry I recall.
Q. You have got a distinct odor of sulphuretted hydrogen?
A. Yes.
Q. When did you get that impression?
A. I think that was about 1907 or 1908.
Q. And you got that from the waters of the river, did you?
A. Yes.
Q. Was any one with you when you noted it?
A. I think that Mr. Provost was with me.
Q. Did you make any note if it any way?
A. Yes.
Q. At the time?
A. Yes.
Q. Have you got it in your note books?
A. Not here.
Q. Have you got it in some note book?
A. Yes.
Q. A distinct detection of sulphuretted hydrogen at that point on that occasion?
A. Yes.
Q. Where else have you detected sulphuretted hydrogen?
A. About the same time or within the same year, I observed the occurrence of similar odors of sulphuretted hydrogen at perhaps half a dozen other points. I cannot now give you those points. I can give them to you later if you wish, by consulting my notes.
Q. Is sulphuretted hydrogen generated so that you can distinguish it in crude and fresh sewage?
A. Not crude sewage, no.
Q. Fresh sewage?
A. No.
Q. What is the age?
A. When I say not in crude, I mean not in fresh crude sewage.
Q. What is the age of the sewage which in your judgment
3029 is necessary to produce sulphuretted hydrogen?
A. Well, it must be of some considerable duration, but that is not enough. Time alone is not enough. Other conditions must be present. The production of sulphuretted hydrogen is too slow a process to render it perceptible to the sense of smell. The resulting gas is confined and accumulates and then is given off suddenly, so that it is impossible to say how long that sewage had been producing that sulphuretted hydrogen.
Q. Well, at the points where you have observed sulphuretted hydrogen and distinguished it, was there also the odor of fresh sewage?
A. I did not observe the odor of fresh sewage at those places not at that time certainly. I think not at those places at any time.

Q. Were there sewers discharging either at the pierheads or slips at those places?

A. Yes.

Q. Sewers of any considerable size?

A. Yes.

Q. Discharging sewage how near the surface of the water?

A. I cannot say what the stage of water was at that time, but some two or three feet under water, I should say.

Q. Sewage rises to the surface immediately?

A. It rises pretty promptly, yes.

Q. When you say pretty promptly, what do you mean by that?

A. Well, almost immediately.

Q. You did not detect any odor from the fresh sewage?

A. Not at those places.

Q. And you observed the odor of sulphuretted hydrogen at those places?

A. That was the main reason why the odor of the other was not discernible.

Q. What is the depth of the water where you observed sulphuretted hydrogen?

A. I did not sound it. I should say it was probably 25 or 30 feet.

Q. That is a guess?

A. That is a guess, yes, an estimate rather.

Q. Estimated upon what data?

A. Mainly on knowledge as to the draft of vessels using those slips.

Q. What vessels were using those slips that you speak of?

3030 A. Some of those were slips where deep draft vessels were accustomed to dock. Others were not.

Q. Taking the one that you distinguished before and have made a memoranda of, what vessels dock there?

A. I presume that slip—I know the draft was not as great—probably the draft was not as great as I before gave you.

Q. Taking the water front of the City of New York as you have observed it in connection with the discharge of sewage about it, which material, in your opinion is the more objectionable, the production and development and detection of sulphuretted hydrogen, or the odor of fresh sewage and the visible evidences of fresh sewage?

A. Well, at any one point, if we had a choice between the two, I would say let us have the fresh sewage. But that is not to be construed as meaning that fresh sewage in general is less objectionable. We shall have the odor of fresh sewage almost everywhere that fresh sewage discharges in some degree, but we do not get the odor of sulphuretted hydrogen until the conditions are such as to favor a considerable accumulation of organic matter, so that the occurrence of the places where sulphuretted hydrogen occurs are smaller in number, but they are more severe when they do occur.

Q. I want you now to take into consideration the whole of the water front of the City of New York and say which, in your opinion, is the more objectionable from the points of view which you have testified to, as to turbidity and effluvia, fresh sewage or the

sulphuretted hydrogen produced by the crude, stale or *spetic* sewage?

A. Both would be. We do not want either one. I have not attempted to take a choice between them.

Q. What in your judgment is the esthetic effect of the discharge of crude sewage in the slips and at the pier-heads of the City of New York?

A. The esthetic effect there is the same as at any other point. I have already described that it is pretty foul. The effect of the sewage being fresh, in my opinion, is that it tends to accelerate the precipitation in a shorter time and thus permits it to get a
3031 shorter distance away before it precipitates. Therefore it tends to render the esthetic conditions more intensely bad immediately at the point and not to extend quite so far away.

Q. Then the ill effect from the esthetic point of view of a discharge of crude sewage along the water front of the City of New York is rather intense?

A. The effect is rather to confine it to a smaller territory and make it worse in that territory.

Q. What do you mean by a smaller territory, a smaller area?

A. Yes.

Q. You do not refer to the distance through which it extends in length?

A. Length is one of the dimensions of the area. I will accept area in substitution for territory.

Q. What do you say in your opinion as to the effect upon pleasure seekers and travelers who come from the State of New Jersey, being compelled to enter the slips and come along by the piers of the City of New York. Is that a matter of esthetic concern?

A. Just as much as it is for the citizens of New York. I judge they are just as intelligent and just as sensitive to offensive conditions.

Q. Can you conceive of any conditions that could possibly be worse, so far as this esthetic point of view is concerned than those which exist along the shore front of the City of New York?

A. Yes.

Q. Where, what are they?

A. Along the Passaic River.

Q. You think that is worse?

A. Yes.

Q. Can you conceive of any conditions which the City of New York can itself produce, which are more objectionable from the esthetic point of view than those produced by the discharge of its sewage into the slips or at the pierheads?

Mr. O'Sullivan: The question is objected to on the ground of its indefiniteness.

The Commissioner: Note the objection of Counsel for Complainants.

A. Yes.

Q. What?

A. Increasing the discharge in quantity without corresponding improvements in the manner of discharge.

3032

Q. Do you know whether the City of New York is increasing in size?

A. Yes.

Q. Is it increasing its discharge of sewage?

A. Yes.

Q. Then it is pursuing the only course you know of for rendering those conditions worse?

A. I said without corresponding improvements in the manner of improving the sewage, and the City of New York is taking steps in that direction.

Q. You have said that the City of Belfast, and the conditions of its harbor are parallel with those of New York?

A. Yes, insofar as it relates to certain features.

Q. What are those features which are parallel?

A. The features which are strikingly parallel in the two cases are the fact that in the City of Belfast the sewage originally was discharged right on the river front of the city, and later a long chute was built by which the sewage was brought down, brought toward the lower end of the—not only to the lower end of City, but carried out a long ways into the bay or lough.

Q. That is parallel, is it?

A. That is parallel to the case of the Passaic Valley. That was the feature in which they are parallel. They immediately found that the undesirable conditions were carried down stream.

Q. And those conditions as you have described them, are parallel with those of the City of New York in what respect?

A. There is no parallel yet in the case of the City of New York to the extension of its outfall sewer down the Bay, but there is a parallel, and that is the one I drew, the parallel is with the proposed extension of the Passaic Valley sewer from the Passaic River down to New York Bay.

Q. In your opinion the sewage that is discharged into the Passaic Valley now gets into New York around the City, does it?

A. No.

Q. Where is the parallelism?

A. It will get near if this sewer is permitted to be built?

Q. Where is the parallel in the two cases?

A. Well, that is the extent of the important part of the parallel. There are other things that are parallel. The configuration of the bay, being a long bay, by which the polluted waters of the bay are prevented from mixing with the ocean is also a parallel that contributes to the conditions that bring about parallel results.

3033

Q. What is the daily discharge in excess of waters over those received from the ocean in the case of Belfast lough?

A. I do not know but it is comparatively small, because the river discharging there has a small drainage area.

Q. When you say "comparatively small" what do you mean by that, what part?

A. Comparing it with the Hudson.

Q. There is not much parallelism between those two features?
A. No.
Q. What is the average rise and fall of the tide in Belfast lough?
A. I think 5 or 6 feet.
Q. What is the average rise and fall in the harbor of New York?
A. 4 or 5 or 6 feet. The average is probably between 4 and 5.
Q. Do you know, are you testifying from knowledge?
A From my observations of the gauge records; also occular examination of the water.
Q. You think that the rise and fall in New York Harbor is nearly as great as it is in Belfast Harbor?
A. I did not say that.
Q. How much is the difference that you have testified to?
A. A coupel of feet. I gave a range of values, because I was not sure enough to be definite.
Q. What is the average depth of Belfast lough?
A. It is comparatively shallow with the exception of a central channel which has been in the main artificially dredged.
Q. How wide is that channel?
A. That channel as I recall it is about 200 feet in width.
Q. And the depth?
A. I presume it is about 30 feet at least.
Q What is the tidal prism of Belfast lough?
A. Well, it is the product of the area triangle, the length about 13 miles, the base about 7 miles by the vertical dimension, whose value is about 5 or 6 or 7 feet.
Q. In gallons, what is it?
A. I cannot tell you.
3034 Q. What is the tidal prism of New York Bay in gallons?
A. I cannot tell you that. I have it in my data. If you wish it, I will look it up.
Q. To what depth does the sea lettuce grow?
A. I do not know the limit of depth to which it grows.
Q. Do you know whether it has any limit?
A. I do not know but I infer it has.
Q. What is your inference based on?
A. My inference is based on the fact that sea lettuce is a chlorophyll plant that depends on sunlight, and it does not get sunlight below certain depths.
Q. Using that inference, to what depth in your judgment does sea lettuce grow?
A. In what harbor.
Q. Any harbor?
A. It ought to demand—I am speaking in an a priori way, inference merely. It ought to depend on the turbidity of the water.
Q. Taking the most favorable conditions that you can imagine, what would the depth be?
A. That is too speculative for me to form an opinion on.
Q. Is it any more speculative than your inference that there is a depth?
A. Yes, I think it is. I think it certainly is more speculative to say a definite depth than to say there is some depth.

Q. Which variety of sewage in your judgment discharged into an equal volume of water of the same character will produce the greater turbidity, fresh or stale?

A. That depends altogether on the conditions over the discharge. If the conditions are such as to cause the sewage which is discharged, the fresh sewage discharged to settle and produce sludge on the bottom, then to purify, I do not see very much difference. If, however, in one case, the fresh sewage is discharged, where there is more or less commingling by currents, then that is dispersed over a wider area, and a greater turbidity will follow the material that has already been highly decomposed, the stale sewage.

Q. Did you not say a little while ago in your testimony that stale sewage having been transported was reduced to finer particles
3035 and would be dispersed more widely?

A. Yes.

Q. Nevertheless you think it would still cause a greater turbidity than fresh?

A. Under the conditions under which I answered your question, yes.

Q. Take the same conditions and apply them to stale sewage?

A. I do not understand.

Q. Take the same currents transporting the stale sewage that you have assumed were transporting the fresh sewage. You think that the stale sewage would produce a greater turbidity?

A. The turbidity will be in one case properly called turbidity, because the material will be finely divided. In the other case it will be an aggregation of large particles with clear water between. I do not know whether you call that turbidity or not? I do not. It would be an offensive condition though.

Q. In your opinion is it desirable to discharge sewage at the surface of the water or at a considerable depth below the surface?

A. At a considerable depth.

Q. Is it desirable to discharge it into deep water rather than into shallow water?

A. If the deep water has a strong current, I should think it is.

Q. If it is not a strong current, is it?

A. I do not think it makes much difference.

Q. It makes no difference how much water containing oxygen lies over the deposit of organically polluted mud?

A. If it has no current the water lying immediately over will soon be exhausted of its oxygen and since there is no current the water immediately around it cannot be mixed with it, so that I do not think it makes much difference.

Q. Now, you are assuming a condition which exists at what point?

A. I am assuming a condition that exists in your question.

Q. Necessarily in my question?

A. Yes. You said without current.

Q. You think that involves no current.

A. I interpreted your question as meaning the absence of current, yes.

Q. You chose to answer me on that?

A. I thought you meant that.

3036 Q. Assuming there is a current?

A. Assuming a slight current, the answer would have to be modified slightly.

Q. Assume as much current as there is in the Hudson River?

A. What times in the Hudson River?

Q. Any time?

A. At the flood of the tide or at the turn of the tide?

Q. Any conditions that you know of in the Hudson River?

A. At what point in the Hudson River?

Q. Any point in the Hudson River?

A. I cannot answer that.

Q. I ask you whether it makes no difference as to the amount of water that is over the muds?

A. There are places in the Hudson River where it does not make any material difference whether it is deep or shallow.

Q. Where are they?

A. Where there is no circulation.

Q. Where are those points?

A. In various parts in slips and bays and inlets, where the only circulation is mainly that from tidal inflow and outflow. The same is true of Gowanus Bay.

Q. Point out a place that you know of. I am not asking about Gowanus Bay. I am asking about the Hudson River. Point out a place in the Hudson River where the conditions exist which you have testified to?

A. No places in the Hudson River where there is not some current at some time, but in some places in the Hudson River there are times when there is no curent.

Q. There are no places in the Hudson River where at times there is no motion of the water above any particular point in the bay, is that your answer?

A. There may be such places, but I do not know of them if there are. While the water is moving nearly all the time, there is, I believe, at nearly every point some times in the day when there is no motion of the water.

Q. And how long in your opinion does that time continue?

A. Well, that is a comparatively short time. It depends on the physiographic configuration.

Q. Does it continue half an hour?

A. Yes, sometimes.

3037 Q. Where does it continue half an hour in the Hudson River?

A. I cannot point out a distinctive place where it does so.

Q. Point out any place at which in your opinion it is likely to continue half an hour.

A. I will change my answer. I do know of one place where it continues more than half an hour.

Q. Where is that?

A. That is opposite the City of Hudson. I have had occasion to

observe it. There is a longer period there when there is no perceptible current.

Q. The City of Hudson where is that?

A. Up the river.

Q. Suppose you confine yourself to this territory?

A. It is about 30 or 40 miles below Albany.

Q. Confine yourself now to the Hudson River in the vicinity of New York. Where is there such a place?

A. I do not know of such places.

Q. In your opinion would it be desirable or would it not to discharge the sewage of the City of New York into deep water?

A. In general, the deep water——

Q. Would the conditions about the City of New York be improved, or would they not, by the discharge of the sewage of the City of New York in deep water at the bottom?

A. You mean at the pierheads or bulkheads?

Q. In deep water at the bottom of the water?

A. Well, I think if that were to take place at the pierhead, there would be an improvement. I think if it were to take place at the pierheads, there would be an improvement. I think if it were to take place at the bulkheads, it would not make much difference.

Q. Well, assuming that the sewage was taken out into the channel and discharged at the bottom of the river, would or would it not in your opinion, improve the conditions of New York Harbor?

A. Well, in one sense it would improve them and in another sense it would impair them.

Q. In what sense would it impair them?

A. It would cause a scattering deposition of the solids over
3038 a large area, making it very difficult, if not impossible to remove it from the bottom.

Q. Would it improve the shore front?

A. By having it confined to the slips as I have already explained, it is more easy to dredge it out.

Q. Would it improve the shore front of the City of New York to discharge it as I have inquired?

A. It would improve certain parts of the shore and impair other parts.

Q. What parts would it impair?

A. The parts where the scattered deposit would be thrown ashore and on the contrary the slips which were freed from the immediate discharge would be improved.

Q. Would it injure any part except where there are no sewers now actually discharging along the shore front?

A. The parts which would be impaired would be the parts where there are no sewers.

Q. And the parts which would be improved are the parts where there are sewers discharging?

A. Yes.

Q. Now, you have given some testimony based upon exhibit No.

135 in connection with the proposed discharge of the Passaic Valley Sewer at Robbins Reef?

A. Yes, sir.

Q. And in giving that testimony you have assumed some character of discharge from that sewer, have you not?

A. Yes.

Q. What is the character that you have assumed?

A. I have assumed that the sewage has the age which it must necessarily have after flowing the distance which it is expected to flow.

At 1 P. M. adjourned for noon recess until 2 P. M.

3039 CORPORATION COUNSEL'S OFFICE,
September 11th, 1912—2 o'clock P. M.

OLIN H. LANDRETH, a witness called on behalf of Complainants, recalled for further examination, testified as follows:

Cross-examination by Mr. Riker (resumed):

Q. What else have you assumed?

A. I am assuming that it has the dilution which might reasonably be expected from an examination of the plans and specifications of the sewer with regard to the absence—or rather the emptying of storm water, and the comparatively small amount of ground water which will probably reach the sewer. In other respects I am assuming that it is substantially a normal sewage from a normal manufacturing population. I do not wish to be understood as implying that the organic matter which is of human origin is the only portion of the organic or mineral matter. The Passaic Valley is quite a manufacturing valley, and it has a number of industries that will doubtless discharge their wastes into this sewer.

Q. That is all you assumed in regard to this discharge?

A. Those are all the assumptions I think of just now.

Q. On what do you base those assumptions as the only ones which should be made as to the discharge at Robbins Reef?

A. I base the assumption as to the age of the sewage by the length of the sewer and the rate of grade which it has, the velocity of the flow of the sewage, and the probable length of time. I base the assumption as to the comparative absence of storm water and the probable small amount of ground water, on the fact that no storm water is officially admitted. If it is, that simply adds that much to the sewage without diminishing the organic matter. Therefore it is not very relevant. I based my assumption as to the organic wastes upon my knowledge of the fact that there are
3040 a number of manufacturing industries in that valley, and by my presumption that since the discharge of their waste into the river would constitute one of the objectionable conditions against which complaints are made in the river, that the building of the sewer will be accompanied by the discharge of those wastes into this sewer in the majority of cases, if not in all cases.

Q. Why do you make no other assumptions as to the character of this discharge as proposed at Robbins Reef?

A. Well, because I think those are the essential important ones. There doubtless are other minor assumptions, which I have made. Those are the main features which go to make it up in character, I think.

Q. Well, in testifying as to what in your opinion would be the result of this discharge now and prospectively, your attention has been drawn to Complainants' Exhibit No. 135?

A. Yes.

Q. Did you make any assumptions in reference to the discharge, so far as it may be affected by that exhibit?

A. Yes.

Q. Well, now, what are they?

A. I did not think you meant to include that under your list of assumptions. That is on the part of the disposal, not a matter that affects the sewage.

Q. It does not affect the discharge at Robbins Reef?

A. Yes, it affects the effluent.

Q. I am asking you in regard to the discharge. The discharge is what I am asking you about?

A. If you mean to include those influences——

Q. Is not the discharge properly dependent on those things?

A. We do not usually speak of such as sewage. That is the effluent from the works.

Q. I did not ask you about the sewage. I asked you about the discharge. That is what I am asking you about, and that is what you were asked about on the direct. That is what I am asking you for now?

A. I understood your question to speak of the discharge of sewage. Then I will correct my last assumptions by saying I did as-
3041 sume that this plant as proposed would be operated. Would be built and operated.

Q. Now, when you say "this plant" what do you mean?

A. A plant at least equal to that which is indicated in the specifications.

Q. What is that?

A. That is a combined plant for screening and for sedimentation.

Q. Now, do you assume that that plant will remove from the effluent enough of the putrescible contents to purify the same to the extent of 10 per cent. upon an absolute putrescible scale?

A. I very much doubt if it will.

Q. Why not?

A. Because primarily when sewage reaches that plant it will be sewage of considerable age, stale sewage, sewage rather finely comminuted, broken up, so that it will not be affected materially by the screens. The objectionable part of the sewage at least will not. The sedimentation in the period which this plant necessitates, will not in my opinion amount to the reduction of probably not much, if any more, than the 10 per cent. you mention.

Q. I asked you whether it would at least produce a reduction of 10 per cent?

A. My opinion is that it will not.

Q. How much will it produce in your opinion?

A. I have not formed a more definite opinion than that. When I say that, I am speaking not only of the suspended matter but the dissolved matter. The matter in solution, the dissolved matter in old sewage will be larger proportionately than it will be in fresh sewage, because during the trip a certain amount of the solids have been liquified by anærobic bacteria. The sedimentation tanks will of course have no effect whatever on the solid organic matter in solution, and it will have comparatively little effect on the solids, if in a fine state of subdivision.

Q. You think it will not purify to the extent of 10 per cent. upon such a scale and you have no idea what it will do. You can form no judgment?

A. I do not think it will 10 per cent.

3042 Q. You have no judgment. You are not willing to express an opinion as to what it will do in the way of removing the putrescible contents of the sewage?

A. Beyond the extent to which I have already answered.

Q. Can you give a per cent?

A. I am indicating the measure of my opinion as to definiteness.

Q. What per cent. do you think?

A. I said it would be impossible for me to reach an opinion as to a definite figure.

Q. Why is it more impossible to do that than it is to say that it will not reach 10 per cent?

A. Well, it is easier to say that a thing is less than 10 than to say that it is 7, or 6 or 5.

Q. Will it reach 9?

A. I do not know.

Q. Will it reach 8?

A. I do not know.

Q. Will it reach 7?

A. I do not know.

Q. Why do you say that it will not reach 10?

A. I do not know that it will not reach 10.

Q. Why do you say that you do not believe that it will when you say that you do not believe it will reach 9?

A. I do not think that I need explain to you the difference in definiteness between saying that it will not reach 10 and saying that it will reach 8 or 7 or 6 or 5.

Q. I asked you if it would reach 9?

A. My feeling that it will remove 9 is stronger than that it will remove 10. My feeling that it will remove 8 is stronger than my feeling that it will remove 9.

Q. The probabilities are greater then that it will remove 8 than that it will remove 9?

A. That is what I mean. I did not think it necessary to say it, but since you have made it so, I will say so.

Q. You have not made a sufficient study of it to enable you to determine whether it will reach 8 or 9 or 10 or any other figure?

A. Yes, that is so.

Q. Have you made any assumptions as the *the* discharge from the Passaic Valley sewer, as to the character of the effluent, in
3043 giving your answer to the hypothetical question which was propounded to you?

A. Yes.

Q. Well, as to the visible suspended particles coming from the Passaic Valley sewage, do you assume that there will be absence of them in New York Bay or do you assume that there will not be?

A. I assume that there will not be an absence of visible suspended matter.

Q. You are familiar with Complainants' Exhibit No. 135?

A. Yes.

Q. You know that the State of New Jersey and the Passaic Valley Sewerage Commissioners guaranteed that such an effluent will be produced?

A. Yes.

Q. You do not believe that they intend to do it?

A. They have appeared to guarantee it.

Q. Appeared to guarantee?

A. Yes.

Q. Will you point out in what respect appearance differs from intention?

A. I will.

Q. Point it out?

A. In this respect, in my mind, there is a wide difference in a guarantee which promises to do something, the verification of which is out of the question and impossible on the one hand and another guarantee which agrees to do the same thing, concerning which there is an adequate means of determining whether the stipulations have been carried out or not. In this instance I do not believe that it is possible to determine the compliance and non-compliance with the purported guaranteed result.

Q. Then your difficulty with it is that the stipulating parties cannot be caught with the goods, is that it?

A. I do not put it quite in those terms.

Q. You do not mean to say that you do not believe it is possible to produce an effluent of that character?

A. I am not assuming that the stipulating parties, either the defendants or the complainants, have any other motive in view than to accomplish what they have promised to accomplish, but I think it is not a question of intention, it is a question of possibility.

3044 Q. And you do not think it is possible to produce an effluent of the character described in this stipulation, being Complainants' Exhibit No. 135?

A. I think it is possible to obtain an effluent under that stipulation, but not necessarily with the plant, which is there described. I do not attach very great importance to that plant, because that is only a suggestion. If that plant does not accomplish the result, you

promise to accomplish it in some other way. My objection is that there is no way of finding out whether you have accomplished it or not. You could not yourself find out, I do not believe.

Q. Your difficulty with it is, that you will not know whether they have done the thing or not

A. That is it mainly, yes.

Q. You do not say that it is impossible to produce an effluent of that character?

A. It clearly is impossible by some plant or other to produce an effluent that would meet those stipulations.

Q. Well, if the State of New York and the Bronx Valley Sewerage Commissioners have stipulated with the United States Government to produce an effluent from which there will be absence in the Hudson River of suspended particles, visible to the naked eye, coming from the effluent, would you think that was possible?

A. I should not think so if they stopped there, but they have not stopped there as I have explained in my direct examination. They have gone two steps ahead of that.

Q. I want to know whether it is possible for them to produce it?

A. Certainly it is possible to produce it, but it is not possible to determine whether it is produced or not in those terms themselves.

Q. Well, what will determine whether that effluent complies with the stipulation or not?

A. Some substituted quantative tests or measure of compliance must be depended on to show whether or not those general results are accomplished or not.

Q. And that test in your judgment would be sufficient if the effluent was purified to such an extent as to remove from it, its putrescible content to the extent of 10 per cent. on an absolute putrescible scale?

3045 A. I do not know whether that would be accomplished at the Bronx Valley outlet or not. Conditions there are very different from what they are at the Passaic Valley outlet. There is no comparison between the conditions.

Q. Will a test of the putrescible contents of the effluent determine whether or not they have lived up to the stipulation?

A. At the Bronx Valley?

Q. Either place?

A. I cannot answer on two different sets of questions with the one answer.

Q. What is the test which in your judgment will determine whether the effluent is of the character that is stipulated in the stipulation between the United States Government and the State of New Jersey?

A. Well, I think for one test alone probably the putrescible test offers the nearest approach to a parallel equivalent result.

Q. How will that test determine whether or not there are suspended particles in New York Harbor coming from the effluent?

A. It will not determine whether or not there are suspended particles.

Q. How will it determine whether there will be suspended par-

ticles visible to the naked eye coming from the effluent in the waters of the Hudson River?

A. It will not determine that directly, except that indirectly the greater the reduction of the putrescible material, the greater is the probability that none of that, or but a small amount of that exists in the form of solid matter, because the dissolved matter is in solution. That cannot be removed by sedimentation or by screening. Therefore, if you are going to reduce the total organic matter by a large or small per cent. you are going to do so mainly by taking out the solids. Therefore, it is an indirect equivalent test.

Q. And you think the proper way of determining whether or not there are visible particles in the waters into which the effluent is discharged is whether or not it stands the putrescibility test?

A. I think if only one test be applied, that is the best one. I do not say that is the only one, nor the one I should recommend, if I had two or three to select from. I should certainly want a stipu-
3046 lated manner of screening, size of the mesh, and the manner of operating the screens, if I wanted to insure direct absence of suspended particles, but if I have only one test, I do not know of any better than the putrescibility test.

Q. And where the stipulation deals with the visibility of the suspended particles, at the point of discharge or anywhere else within the waters of the harbor, you think the proper way of determining whether they are visible or not, is by applying the putrescibility test?

A. I do, if there are other results to be accomplished. But if there is only one stipulation to be accomplished, and that is the absence of visible particles, then I should not select a putrescibility test. I should select one of screening, a screening specification. But in your agreement between the State of New Jersey and the United States Government, you have stipulated many other things.

Q. I am dealing with this one and I want to know what your assumption is as to the effluent complying with that particular stipulation. Do you assume that it will or will not?

A. I assume indirectly that it will accomplish necessarily some considerable reduction in the suspended particles.

Q. Do you assume that it will comply with the stipulations or do you not, yes or no?

A. Are you asking in reference to the Passaic or Bronx Valley?

Q. I am asking you with reference to the stipulations contained in Complainants' Exhibit No. 135, being the stipulations between the United States Government and the State of New Jersey and the Passaic Valley Sewerage Commissioners?

A. In that there is no test of 10 per cent. of the putrescibility stipulated.

Q. I do not ask you that. I am asking you whether you assume that the effluent will or will not comply with the stipulations.

Q. With the stipulation that there will be absence in New York Bay of visible suspended particles coming from the Passaic Valley Sewerage?

A. That I have answered some time ago.

Q. I ask it again?

A. I do not believe they will secure those conditions.

3047 Q. Do you assume it, or don't you?

A. Well, I do not assume it.

Q. If such a result is in fact obtained, will there *will* any effect from the discharge upon the beauty of this gateway of commerce?

A. Yes.

Q. What?

A. The turbidity.

Q. Will there be turbidity, is it possible that there will be turbidity without suspended particles?

A. That may not be visible particles.

Q. You cannot see them?

A. No.

Q. Still there may be turbidity?

A. You cannot see them individually. You can see them simply as a mass of cloudy, opaque manner in the water. You cannot see any single particle perhaps.

Q. Then you distinguish between individual particles that are visible and particles that are visible in turbidity?

A. Yes, I cannot see down through a bottle of ink. I cannot see the particles of ink.

Q. You think that clause of the stipulation may be observed and controlled, the effect upon the beauty of the waters of this great gateway of commerce?

A. I do.

Q. Well, do you assume that there will be a practical absence on the surface of New York Bay of any grease or color due to the discharge of the Passaic Valley sewage at the dispersion area or elsewhere?

A. No.

Q. You do not assume that?

A. No.

Q. You assume that there will be, don't you?

A. Yes.

Q. Why do you assume that?

A. Because I believe it.

Q. Is it not possible to produce an effluent that will not have grease or color?

A. Not by screens or sedimentation.

Q. I did not ask you that. I asked you whether it was possible to do it?

A. Yes, pretty difficult though.

Q. If the stipulation between the United States Government and the sovereign state of New York provides that there will be practical absence on the surface of the Hudson River at the dispersion area or elsewhere of any grease or color due to the discharge of the sewage, do you assume that that will be carried out or not?

A. Not if they stop there, no.

Q. Whether they stop there or not, do you believe that that will be carried out?

3048 A. It makes a difference whether they stop there or not.

Q. What difference does it make?

A. They have not stopped there, those other things are in there.

Q. What other things are added?

A. Will I go over it again?

Q. No, what have they added which destroys the effect of that stipulation?

A. They have not added anything that destroys the effect of the stipulation. They have added something that tends to make the stipulation stronger.

Q. It is possible to produce that result, is it?

A. Oh, yes.

Q. If it is possible to do that in the Bronx Valley case, it is possible to do it in the Passaic Valley case?

A. Yes.

Q. Then why do you assume that it will not be done?

A. Because you have not agreed that you will stand any of those tests, and the government, or any other party adverse to you, would find it impossible to prove that you were not doing the things that are prohibited there. In other words they would find it impossible to prove that you were doing the things that you have promised there not to do.

Q. That is another case of not being able to catch them with the goods?

A. If you prefer to put it in those terms, I will be obliged to accept them, though I do not like the terms.

Q. You assume that it will not be done, although it can be done?

A. I assume that it will be impossible to determine whether it is done or not,—whether you want to do it or not has a secondary relation to the question. You may be ever so sincere in your effort, but I do not believe it would be possible to ascertain whether it was done or not, I do not believe that you will be receptive to any intimation that you are not doing it until it has been shown that you are not doing it.

Q. Well, if it is not possible to determine whether we are doing it or not at Robbins Reef, what injurious effect will it have, in your judgment, upon the sovereign state of New York or any of its inhabitants, the making of a discharge there, which cannot be shown to produce this result?

3049 A. Why, it may have the very serious effect of seriously adding to the pollution of the bay even by very large amount and still it may be impossible to prove the identity of that sewage which does it.

Q. Is that because all of the waters of the bay will have been so polluted by the operations of the New York sewers, that it will be impossible to detect the discharge into the waters of this effluent?

A. It will be because the waters of New York Bay are polluted from various sources, from New York City, from other up State territory, from New Jersey territory, not included in the Passaic Valley, and other sources. This agreement makes it obligatory on the Government to identify the cause with the particular sewage

which comes through that particular sewer from the Passaic Valley. That burden I think is an impossible one to carry.

Q. And nevertheless in your testimony you have said that in your judgment the discharge at Robbins Reef of the Passaic Valley Sewer will so mar the beauty of the waters of New York Harbor and New York Bay, that it will interfere with the esthetic sense of the residents of New York. Do you still say that?

A. I do. And I do not mean to say that I think the beauty will be marred any more than by an equal amount of sewage from any other source. I am not drawing state lines.

Q. If the discharge at that point is of such a character that its presence cannot be detected, you think it still will have a real effect upon the marring of the beauty of the waters of New York Bay, do you?

A. I think it can be detected, but it cannot be detected necessarily as coming directly from the Passaic Valley Sewer.

Q. How can it be detected without its being plainly chargeable to the Passaic Valley Sewer in your opinion? Is there any other sewer discharging any where near that part?

A. There may or there may not be. I am assuming that there are not.

Q. Don't you know that there are not?

A. Yes at present.

Q. Then what is it that you are afraid of as preventing the detection of this injurious result?

3050 A. I should expect the burden of identification and proof would be much easier if the results in the direction of pollution were confined to the immediate vicinity of that outlet. Unfortunately they will not be. They will be scattered and spread about. Since the sewage is of considerable age, in fact stale sewage when it reaches there, it will not settle suddenly, but will be deposited and scattered throughout the harbor so the injurious effect will be carried up to the City and even to the Staten Island, New Jersey and Brooklyn shores. Hence the difficulty of the identifying the added harm with the sewage which came out of the outlet of the Passaic Valley Sewer.

Q. So that you are of the opinion that there will be no more marked visible effect at the point of discharge than there will be elsewhere throughout the harbor?

A. I did not say that at all.

Q. Is that your opinion?

A. No.

Q. If there is a more marked and visible appearance of this sewage at the point of discharge, will you have any difficulty of identifying it?

A. There might be because the sewage from other territories will pass there, be carried there.

Q. How will it be carried there?

A. We have not any comparative scale to compare the conditions that existed before the sewer with what will exist after the sewer. We have not any photographic or other means of representing the

present condition of the harbor as to those items which you have chosen to put into the specifications.

Q. We chose to put them in—you mean the United States Government chose them?

A. The party who made it, and the other party became a party to it.

Q. The United States chose to insert them in the Bronx Valley agreement, as you understand it?

A. The United States has become a party to the specifications, which contain those same items, but they also contain other items which save it from being fatal.

3051 Q. Were the other items the important ones in your judgment, in the Bronx agreement as you understand it?

A. They are, so far as first the verifications and second the future improvements demand.

Q. I am not speaking about the future improvements. I am talking about the verifications. In your judgment is there anything else except the provision that the partial purification by screening and sedimentation, with an efficiency sufficient to remove—which shall at all times remove from the effluent, enough of the putrescible content to purify the same to the extent of 10 per cent. on an absolute putrescible scale?

A. Yes.

Q. What else is there?

A. The other is that if it shall be found by experience in five years necessary then the State of New York binds itself to submit to subsequent examinations by the Secretary of War as to the carrying out of added improvements, such as may be found necessary by that subsequent inspection. Your State has not agreed to do that.

Q. You do not think it of any importance that there should be a provision in the stipulation that there will be absence in the Hudson River of suspended particles visible to the naked eye coming from the effluent of said sewer?

A. That is going back to the last question.

Q. I want you to answer it in connection with the comparative value of that provision as to the putrescibility?

A. Taken by itself while it appears to be important, it is not sufficient, because it is not unobjectionable. Taken in conjunction with the other it becomes very important.

Q. Does it add to the putrescibility test?

A. The putrescibility test adds to that.

Q. I am asking you whether it adds to the putrescibility test?

A. Quite the contrary. The putrescibility test adds to that.

Q. Then this is important standing by itself?

A. What do you mean by this?

3052 Q. That there will be absence in the Hudson River of suspended particles visible to the naked eye, coming from the effluent of said sewer?

A. I have just said several times that I do not think that in

itself it would be unobjectionable. Taking it in conjunction with the other test it becomes strong.

Q. How does it become strong by adding the putrescibility test?

A. Because it is entirely feasible to apply the putrescibility test. It is not feasible to apply a test couched in terms of your agreement.

Q. And the putrescibility test is the only feasible test which can be applied?

A. I have not said that at all.

Q. If the putrescibility test is the real test what is added to that test by the provision that there will be absence in the Hudson River of suspended particles?

A. That does not add anything to it, but on the contrary the putrescibility test adds to the other.

Q. It not only adds to it, but it suppresses it, takes it away. It is the only thing that is necessary?

A. No, it is not because it does not suppress it. It is co-related with it and represents the minimum which must be accomplished and even more still, if it is found necessary.

Q. What is the more?

A. To any extent that is found necessary by 5 years' experience. They agreed to remove 10 per cent. at once. Then they agreed to remove any added amount necessary after five years' trial.

Q. As you understand they agree that there will be absence in the Hudson River of suspended particles visible to the naked eye coming from the effluent. Does that mean anything?

A. Standing alone it means very little.

Q. In connection with the putrescibility test what does it mean?

A. It means that in order to secure that you must remove—probably must remove a very appreciable part of the solid matter, and probably enough to accomplish that, for the reason that your removal by a plant will be confined largely to the solids and not to the solvents, the dissolved matter.

3053 Q. Now, I want to read you a little clause, and ask you whether you would give any meaning to it. At all times during the operation of the Bronx Valley Sewer system, in addition to those specified in the paragraph immediately above, the requirements enumerated under the seven heads immediately following will be met either through the plant in the stipulation above called for or through requisite additional arrangements?

A. Yes, I gave meaning to that.

Q. Do you give the meaning to it, that plant that is described and referred to in the part that I have read will produce the results which immediately follow?

A. The meaning I give to it is whether or not the plant thus described will give those results or not, the State of New York agrees to add other plants.

Q. Well, I read to you from Exhibit No. 135, the second general paragraph, the Passaic Valley Sewerage Commissioners further agree with the United States that in the operation of said sewer system at all times the following results shall be secured, either through com-

pliance with the immediately preceding paragraphs, or through requisite lawful additional arrangements.

Mr. O'Sullivan: I object to the question on the ground that it calls upon this witness to express a juridic opinion, which he has not qualified himself to give, as to what is or what is not lawful.

The Commissioner: Note the objection of Counsel for Complainants.

Q. Well, do you give any meaning to that?

A. I give meaning as far as I can.

Q. Why cannot you give any full meaning to it?

A. Because I do not know what would be lawful in your State.

Q. That is your trouble, is it?

A. I do not know what the debt limit may be, at that time. I do not know what difficulties there may be in securing by legislation the appropriate funds, securing the necessary authorization to take property, raising the taxes. I do not know any-

3054 think about those. Those all go to the word "lawful."

Q. Your trouble is as to what we can do in the State of New Jersey in the way of raising money, is it?

A. Partly, not entirely.

Q. Leave out of consideration the word "lawful" for the time being, and then I ask you what effect you give to that part of the stipulation contained in Exhibit No. 135?

A. I do not see that it is necessary to go on and show what must be done in case you do not do a thing, when it has not been proven that you have done it. That is my chief objection to the whole contract. You cannot prove whether it has been done or not.

Q. If the only satisfactory way of accomplishing that result is to remove 10 per cent. of the putrescible matter in the effluent, cannot you determine whether that has been done or not under the stipulation contained in Complainants' Exhibit No. 135?

A. If Exhibit No. 135 had contained such a clause, then it would be clearly possible to see whether there was compliance or not.

Q. If Exhibit No. 135 had contained the 10 per cent. putrescibility test in your opinion would the effluent that is stipulated for be produced?

A. I cannot say. I think the chances are somewhat favorable to it. I cannot say that it would not. It would be impossible to determine whether it would remove 10 per cent. or not.

Q. Would it be possible with the putrescibility test to determine whether there would be absence of visible suspended particles in the waters of New York Bay coming from the Passaic Valley sewage?

A. Except by indirect inferences.

Q. Would it be possible to determine it in any other way?

A. If so, I do not know that other way.

Q. Still you say this effluent if produced as stipulated will injuriously affect the beauty of the waters of New York Bay?

A. I said it would yes, in my opinion.

Q. You have testified that in your belief there would be

3055 odors produced from the discharge of the effluent from the Passaic Valley sewage. On what do you base that?

A. On my knowledge of sewage outfalls and the odors which attend stale sewage.

Q. Well, had you in mind the fact that in the stipulation to which I directed your attention, there is a provision that there will be absence in New York Bay and vicinity of odors due to the putrefaction of organic matters contained in the Passaic Valley sewage thus discharged?

A. If that is there; yes, sir.

Q. Are you assuming that the effluent will comply with the stipulation?

A. I am assuming that it will not be possible to ascertain whether it has or not.

Q. And still you think the odors from that sewage will be sufficient to be perceptible?

A. I do and add perceptibly to the pollution of the harbor and the odors.

Q. Where?

A. Wherever the Jersey sewage settles on the bottom and putrefies.

Q. Cannot you predict any place at which they will be perceptible?

A. I think there will be comparatively few places where it will not settle in some measure. I cannot indicate where the greatest settlement will take place, nor where the least.

Q. Will there be any marked excess of odors at any point of discharge as compared with the rest of the Bay of New York?

A. Well, I am inclined to think that there will be some concentration there so far as deposits of sewage are concerned, but I do not wish to be understood as saying that they will be confined there, but on the contrary the septic sewage will tend to scatter and be deposited over a wider area than fresh sewage.

Q. I am asking you a question, which you apparently answered, that there will be concentration at the point of discharge. You have answered it, have you not, in that way?

A. Yes.

3056 Q. Then why can it not be determined whether the stipulation is being complied with or not?

A. I am tired of giving my reasons for it. I will give them again if you wish.

Q. I do wish you to?

A. Simply the difficulty of verifying the fact that the odors do come, by legal proof, from that sewer. We may all believe it. It may be a matter of common knowledge, still common knowledge does not go before courts and commissions. It ought not to be necessary even for a layman to refer to the difference between common belief and common understanding and knowledge and legal proof.

Q. And you think the association between a sewage discharge of the character of the Passaic Valley project, as you understand it, and the presence at the immediate point of the outfall of the con-

centration of odors, is not such a close connection as to carry conviction to the minds of court and jury and other legal bodies?

Mr. O'Sullivan: I object to the question. That is wholly speculative, calling for a phychic process on the part of a court, on things that are not even in esse.

The Commissioner: Note the objection of Counsel for Complainants.

A. If there were no other discharge of sewage into the harbor, and even granting that there were, if there were no other increase of sewage discharge from other sewers, it would be impossible by comparison to determine whether or not there had been an increase in the odors at that point, and if we found there had been, we might logically infer that the cause must be the Passaic Valley alone, but New Jersey, Jersey City, Hoboken, and Weehawken, New York and Brooklyn, may all be increasing their discharge enough to complicate the line of legal proof and I do not want to have to depend for the proof of a question on various indirect processes, which are liable, even though indefinite to be still further destroyed by other parties entering in and doing the same thing that we are charged with doing.

3057 Q. It is once more a suggestion that in this stipulation the State of New Jersey may rely upon not being caught with the goods, is that it?

A. I will leave you to frame those terms. If you prefer that sort of reference.

Q. You cannot answer it.

A. I can. I have made myself plain.

Q. Answer it again please?

A. Not in those terms. I will not even insult the State of New Jersey by using those terms.

Q. Well, now, Professor, will you assume that in the operation of the Passaic Valley Sewerage project there will be an absence in the New York Bay of visible suspended particles coming from the Passaic Valley sewage; that there will be absence of deposits objectionable to the Secretary of War of the United States into New York Bay, coming from the Passaic Valley Sewer, and that there will be absence in New York Bay and its vicinity of odors due to the putrefaction or organic matter contained in the Passaic Valley sewage thus discharged; that there will be practical absence on the surface of New York Bay of any grease or color due to the discharge of the Passaic Valley sewage at the dispersion area or elsewhere; that there will no injury to the public health, which will be occasioned by the discharge of said sewer into the Bay of New York in the manner proposed, and that no public or private nuisance will be created thereby; that there will be absence of injurious effects from said sewage discharge upon the property of the United States situated in the harbor of New York; and that there will be absence in the reduction of the dissolved oxygen content of the waters of New York Bay resulting from the discharge of the Passaic Valley sewage, to

such an extent as to interfere with major fish life, and then tell me what injurious effect will result from that discharge?

A. I think that if I assume all those things as having been accomplished, that the injurious effect will be reduced to a very small amount.

Q. In what will they consist?

A. I have not considered what remaining objections there
3058 may be. I have not felt safe in assuming that they would be absent.

Q. I ask you now to assume that this stipulation is being complied with in all its terms. That is what I am asking you to assume. Now I ask you what injurious effect will be produced by the discharge of such an effluent?

A. I think if all those were accomplished faithfully, the remaining objections would be unimportant.

Q. You think that would be practically distilled water, would you?

A. No.

Q. What would it be?

A. It would be a reasonably pure river water, subject to its ordinary pollution, and the ordinary burden of sewage.

Q. And not beyond the reasonable hope of production?

A. That goes to the assumption. I have assumed that that is the case.

Q. I am now asking whether such an effluent can be expected to be produced by means that are within your expert knowledge?

A. I repeat again I think they can be accomplished but I do not believe you can tell whether they have been accomplished or not, and I do not believe they can be accomplished by the plant proposed.

Q. I did not ask you that. I asked you whether they could be accomplished?

A. They can be accomplished, I think.

Q. Do you look upon them as rather visionary, those results?

A. I should not call them visionary. It is within the reach of an ordinary measure of perfect sewage disposal treatment.

Q. As a practical matter it is beyond the reasonable requirements of sewage disposal?

A. It is not any more severe than is required of a number of effluents that are in operation now.

Q. Would you call it distilled water, I ask you that again?

A. No, sir, I certainly would not.

Q. Do you understand that is the standard required from the Bronx Valley sewer?

A. Distilled water?

Q. No, the same as this stipulation between the United
3059 States and the State of New Jersey?

A. Yes.

Q. And if one requires distilled water the other does?

A. Yes. One provides a way of finding out whether it is complied with and the other does not.

Q. If they both do the same thing the result will be the same in the two stipulations, as you understand it?

A. If they both do the same thing, if they both do the same thing of course.

Q. And if the one produces the result that is required by its stipulation, and the other does the same thing, would it produce the result required?

A. Not necessarily at all.

Q. Are not the stipulations exactly the same as you understand them?

A. I would not say that you could do it by doing the same thing. Your words "same thing" imply that you mean the same kind of plant. The plant that would produce those results in one place would not necessarily at another place.

Q. Not necessarily, you might have to add some additional processes, is that so?

A. A good many things are different in the two cases.

Q. What are they that are so different?

A. In the first place the character of the sewage is different.

Q. In what respect?

A. The character of the sewage from the Bronx Valley is much more dilute, it is much more thoroughly oxygenated when it reaches the point, and there is much less of industrial waste and much less of antiseptic chemical element in it. It is discharged into a different form of estuary or chanel, and has an altogether different set of surrounding conditions. It is in a different part of the waters. The degree of salinity is different. There are a good many things that will make it necessary to design a different plan, a different set of processes to accomplish the same stipulated result in one case as in the other, and I am not willing to say that the same thing would accomplish the result, if by "same thing" you mean building the same plant.

3060 Q. How long is the Bronx Valley sewer?

A. The length from the upper extremity,—not far from the length of the Passaic Valley sewer.

Q. What will be the relative ages of the sewages when they reach the disposal points?

A. The relative age of the sewage will be much younger in the case of the Bronx Valley, because the large populations lie nearer to the mouth of the sewer.

Q. Is that so?

A. Yes, sir.

Q. Comparatively is there any large population nearer with relation to the disposal works of the Bronx Valley, than Newark is to the proposed disposal plant?

A. No. but Newark lies much farther up stream comparatively than do the large municipalities in the Bronx Valley.

Q. How much farther up stream—I suppose by that you mean up the sewer?

A. Yes.

Q. How much farther up does it lie?

A. I have not scaled it off in miles, or I have not found the exact center of gravity of the population, but I should say it was on the average, three or four miles farther up the sewer.

Q. You think so, do you?

A. Yes.

Q. Have you based that on any attempt to determine the measurements?

A. No.

Q. Do you know whether or not the proposed disposal works are or are not within the City of Newark?

A. What do you mean by disposal works?

Q. I mean where the sewage is to be treated so as to produce the effluent?

A. I assume it is, but not within the populous portion of the City. Within the official city bounds or limits.

Q. Is the proposed disposal plant of the Bronx Valley within the populated part of any city?

A. No, it is not.

Q. How far is it from the population center?

A. It may be a couple of miles.

Q. What do you mean by that; is that the edge of the populated district; or is that the population center where you say it is a couple of miles?

3061 A. I should say it is getting into the populated area. I would not say it is the population center.

Q. Do you know how far it is from the location of the proposed disposal plant of the Passaic Valley sewer to the populated part of the City of Newark?

A. I do approximately, but I want to insist that it is not the location of the disposal works that is the critical thing. It is the point of outlet into the river, and when you consider that the center of gravity of the contributing population in the Passaic Valley is certainly farther up the sewer than occurs in the case of the Bronx Valley from the outlet to the center of population,——

Q. I want you to answer my question.

A. I have answered it.

Q. If you know how far it is from the proposed location of the Passaic Valley Sewer disposal plant to the populated part of the City of Newark?

A. Yes, approximately.

Q. How much?

A. Two or three miles.

Q. About the same as in the Bronx?

A. Well, at the Bronx, the disposal works are practically contiguous to the outlet.

Q. I did not ask you that.

A. That is a critical point.

Q. You are volunteering testimony. You are not answering my questions. This is cross examination and I do not ask you to volunteer, I ask you to answer my questions.

A. All right.

Q. When you spoke of the treatment of sewage at these treatment works or disposal plant, you said that it was influenced, did you not, by the condition of the sewage which was received at the plant?

A. I very likely did say so. I do not recall it now.

Q. In what respect does the sewage of the Passaic Valley Sewerage District, when it shall reach the disposal plant as proposed, differ in character from that of the Bronx River Sewer?

A. Well, the sewage will be less stale; will be more nearly fresh sewage.

Q. Why is that so?

A. Because as I have already said, it will have a shorter distance to flow.

3062 Q. Is it not a fact that the length of the sewer is as great as the length of the Passaic Valley sewer?

A. Substantially.

Q. Is it not a fact that the populations, the large populations in both cases are practically within two or three miles of the sewage disposal plant?

A. That is so of the Bronx Valley more so than the Passaic Valley.

Q. What percentage is it more so?

A. I do not recognize that Newark alone is the only city or even the only large city that contributes to the Passaic Valley sewer. The city of Paterson which is a very decent sized burg, is at the extreme upper end of the sewer.

Q. I want you to give me your idea, if you can give me any idea, of the percentages of locations of populations and therefore the percentages of sewage as they reach the respective plants of the Passaic Valley sewer and the Bronx Valley sewer?

A. If I had anticipated your questions, I would have prepared myself to answer. I am not prepared as it is.

Q. You are not prepared to answer those questions. Now, the sewage of the Bronx Valley, where is its normal and natural outlet to, to which body of water?

A. Speaking of the Bronx Valley sewer?

Q. The sewage of the Bronx Valley which is served by the Bronx Valley Sewer, where is its natural outlet into which body of water?

A. I do not think that I understand what you mean by natural outlet.

Q. I do not know that I do either, but the term has been used a good many times by experts in this case. Where would it discharge by gravity along the water courses?

A. You mean if it was discharged into the water courses?

Q. Yes.

A. Discharge in the Bronx River and flow into Long Island Sound or the East River.

Q. And then by the construction of this sewer, if it is put in operation, this sewer will discharge into the Hudson River opposite New Jersey, will it?

A. Yes.

Q. What is the population of the Bronx Valley to be
3063 served by this Bronx Valley Sewer?

A. I do not carry the figures in my mind.

Q. Is it large or small?

A. Small as compared with the City of New York, and small as compared with the population of the Passaic Valley.

Q. Well, can you give a percentage?

A. No.

Q. You cannot indicate any more definitely what it is?

A. I can readily verify it. If you wish I will look up the figures. It is so easy to ascertain that I do not burden my mind with those things.

Q. Do you know whether there are 50,000 persons in the Bronx Valley?

A. More than that.

Q. Are there 500,000?

A. No.

Q. Are there 300,000?

A. No.

Q. Are there 200,000?

A. Not tributary to this sewer.

Q. In your opinion, Professor, if there is removed from the sewage 10 per cent. of its putrescible content, upon an absolute putrescible scale, and that effluent is then discharged into the Hudson River, will there be from that effluent an absence of suspended particles visible to the naked eye in the Hudson River?

A. I cannot tell.

Q. Will there be an absence of deposits in the waters of the Hudson River coming from the effluent?

A. I cannot tell.

Q. Will there be an absence in the waters of the Hudson River and the vicinity of odors due to the putrefaction of organic matter contained in the effluent?

A. I cannot tell.

Q. Will there be practical absence on the surface of the Hudson River at the dispersion area or elsewhere of any grease or color due to the discharge from the sewer?

A. I cannot tell. I do not think that there will be.

Q. Will there be no public or private nuisance occasioned by the discharge of such an effluent?

A. I cannot tell.

Q. Will such an effluent seriously affect the property of the United States in the Hudson River?

A. I do not know.

Q. What is the value of that test then in the stipulation?

A. In that we know that we can insist on and can enforce
3064 the regulation to make a certain definite improvement represented by the 10 per cent. That we know that we have got. Whether it does the other things or not is another question. We also know that we have only got to wait 5 years before we can insist on that being raised, if it is found necessary.

Q. Now, Professor, you see that you are volunterring again. I am asking you whether by that test you can tell whether the effluent

will produce certain results? I did not ask what would happen in 5 years.

A. I have answered you fully, I think.

Q. So that if this paper which you have produced here is a correct duplicate of a stipulation entered into between the United States of America and the people of the State of New York and the Commissioners of the Bronx Valley Sewer, the only thing that is definite for the ensuing 5 years is, that the effluent shall be purified to the extent of 10 per cent. of putrescible matter?

A. No, I did not say that.

Q. What else is there definite in it?

A. We have got that, and we have got at least as much certainty, in fact the greater certainty of some improvement coming from the other requirements. It would be much more easy to identify the sewage which comes from the Bronx Valley sewer as coming from that sewer than it would be to identify the sewage which comes from the Passaic Valley sewer as coming from that sewer.

Q. Why?

A. Because in the case of the Bronx Valley sewer it is situated above all the other large polluting municipalities.

Q. How far?

A. It is several miles above the uppermost of the New York City sewers of any size.

Q. How many miles?

A. Oh, some eight or ten miles above, I should say, the large sewers at least, and more than that. 10 or 12 miles and in just the proportion that it is removed from the others will the burden become easier, to identify, that is the conditions in the river with the discharge from this sewer. If the Passaic Valley sewer were off by itself, removed from all others, the burden would be much easier than it is at present.

3065 Q. Where is it with reference to Mt. St. Vincent?

A. Close by. Mt. St. Vincent is a very small establishment.

Q. Do you happen to know what the condition of the pollution of the river waters of the Hudson River at Mt. St. Vincent is?

A. I have data on it at my office. I have not that in my mind. The water is very much better in that region than it is opposite the City of New York, opposite the State of New Jersey.

Q. You say it is very much better?

A. Yes, sir.

Q. Than the conditions at Robbins Reef for instance?

A. Than the conditions at Robbins Reef?

Q. Yes.

A. They are better than they are at Robbins Reef, at some tides, and I think at all tides.

Q. Much better?

A. Why I should say appreciably better. There again I am depending on mental recollection when I have the data to refer to.

Q. You have testified that by reason of the condition of the Hudson River at the mouth of the Bronx Valley sewer it will be easier to

detect the violations of the stipulation, than it will be at Robbins Reef?

A. Yes.

Q. Will the oxygen content at the two points in your judgment, give a fair indication of the relative conditions of the waters at those points, so far as detecting the effluent is concerned?

A. If the oxygen content had been obtained for a whole cycle of a year and at all phases of the tides, you then would get a very fair suggestion as to the relative capacity of the waters for handling sewage.

Q. For how long a period do you think you would require to take these oxygen determinations, in order to make them of any value?

A. One single one is of some value.

Q. Well, of any considerable value?

A. They would not have the highest value until they had gone through a year, distributed at different phases of the tide.

Q. I show you Complainants' Exhibit No. 168, and point out to you an oxygen determination up the Hudson River of 78 per

3066 cent. Do you see that? (Witness examines exhibit.)

A. Yes.

Q. That is where, do you recognize the location of that determination?

A. That would be at,—I should say quite a distance below the upper boundary of the City of New York.

Q. That is at Mt. St. Vincent?

A. It may be as high as that, yes.

Q. Well, look at the oxygen determination at or about Robbins Reef?

A. Yes.

Q. Now, taking those indications of the condition of the water, do you think the discharge of the Bronx Valley sewer at about Mt. St. Vincent, will be more likely to be determined as to its effect with reference to the stipulation than the discharge of the Passaic Valley sewer at Robbins Reef?

A. The sewer from the Bronx Valley is above Mt. St. Vincent.

Q. How much?

A. Quite a distance. I do not quite locate Mt. St. Vincent, but the outlet of the Bronx Valley sewer is above this point, this mark 78. Even here the water showed to be better than it is at Robbins Reef except on one day when it happened to have the same percentage.

Q. Why do you say one day?

A. Well, it was observed on three days, October 16th, 23rd and 24th. On October 16th the oxygen content at Robbins Reef was 72 per cent. On October 23rd, it was 74 per cent. On October 24th it was 78 per cent, which is the same as it was on the point on the Hudson that you designate as Mt. St. Vincent.

Q. I ask you whether you do not designate it as Mt. St. Vincent?

A. Not definitely. I say Mt. St. Vincent is somewhere in that vicinity. I cannot tell by that map just where it is in fact.

Q. I draw your attention to some lettering on the exhibit Hudson River, Mt. St. Vincent, October 13th.

A. Yes.

Q. Do you see any other determinations there indicating it was at Mt. St. Vincent than the one pointed out?

A. No.

Q. Have you any question that that is not Mt. St. Vincent?

A. I do not dispute it, if that is the one referred to.

3067 Q. You think so?

A. There is nothing here to indicate.

Q. You do not think anything about it?

A. Without seeing the testimony of the witness who presented it, I do not know.

Q. Where is Mt. St. Vincent?

—. Approximately where this value of 78 is located.

Q. On the Hudson River?

A. Yes.

Q. Is there any other determination shown by that exhibit which would correspond with Mt. St. Vincent?

A. There is not any there, but there is not any mark upon it to indicate where Mt. St. Vincent is, or where these other points are. I am depending on assuming that the figure placed at the station here was meant to indicate Mt. St. Vincent.

Q. Assuming then that the station that is indicated there on the Hudson River marked 78 per cent. is at Mt. St. Vincent, How far is that from the mouth of the Bronx Valley Sewer, if you know?

A. I have testified that I do not know the distance. It is some considerable distance below the mouth of the sewer.

Q. What considerable distance are you speaking of. What do you mean by a considerable distance, miles?

A. I think it is at least a mile. I want to repeat again I have not been concerned with Mt. St. Vincent, therefore I have not taxed my mind with its distance from any other particular point.

Q. And during the first five years of the operation of the Bronx Valley Sewer, as you understand it, what population is it to serve?

A. I have already answered that.

Q. Answer it again.

A. I do not know.

Q. More than 200,000?

A. I think less than 200,000.

Q. How many inhabitants, human beings, do you understand the Passaic Valley sewer is to serve when it is first opened?

A. It will be more than that. *It* do not carry the number in my mind.

Q. 750,000?

A. In that direction.

3068 Q. And you think it will be more easily determined whether the Bronx Valley Sewerage Commissioners are complying with their stipulations with the United States Government than it will be to determine whether the Passaic Valley Sewerage Commissioners live up to theirs?

A. Yes.

Q. For the reason that the water at the point of discharge of the Bronx Valley sewer is purer than it is at the point where the Passaic Valley Sewer is to discharge?

A. Not at all.

Q. Why then?

A. Because of a more definite form of test stipulated in the agreement with the Bronx Valley Sewer Commission.

Q. I am not talking about any test. I am talking about these results which you said it could not be determined as to whether or not they would result from the putrescibility test, but could be detected in actual fact from the difference between the points of discharge in the waters at the points of discharge of the two sewers. Now, leaving out the putrescibility test and dealing with the effluent as described, do you think that that can be more readily determined as to the Bronx Valley Sewer than it can as to the Passaic Valley Sewer, that is, whether that effluent as prescribed and described, is in fact being produced?

A. Yes, I think even leaving that out it will be easier to prove the case.

Q. Why?

A. For the reasons stated before. Not because the water is purer, but because it is farther removed from other disturbing and confusing municipalities.

Q. How far is the proposed outlet of the Passaic Valley sewer from any existing sewer that you know of?

A. Well, it is below a good many and above a good many.

Q. How far is it from the outlet of any sewer so far as you know?

A. Well, perhaps a mile and a half or two miles from several sewers on Staten Island and a somewhat longer distance from several sewers on the East River in lower Brooklyn; twice as far perhaps from the several sewers situated nearest to it in Manhattan.

Q. How far?

3069 A. Twice as far perhaps at least, depending on how many sewers are included. In other words, there are sewers all around the Passaic Valley outlet, and there are no large sewers above the Bronx Valley outlet.

Q. How do you account for the percentage of dissolved oxygen at Mt. St. Vincent being reduced to 78 per cent.?

A. That may have been taken on a flood tide. I do not know what the phase of the tide was there.

Q. Does it indicate pollution to your mind or does it not?

A. There is some suggestion of its being taken on the flood tide when the water was coming up from New York.

Q. I do not ask you that. I asked you whether it indicated pollution?

A. It indicates some pollution, yes.

Q. About as much pollution as at Robbins Reef?

A. No, not so much.

Q. About as much?

A. Substantially, yes.
Q. At what depth does the Bronx Valley sewer discharge?
A. I think the specifications call for 30 or 40 feet in depth.
Q. Well, the sewer has been in partial operation, has it not?
A. It has.
Q. Have you seen it?
A. Yes.
Q. Do you know the actual depth of the outlet?
A. Approximately. It is not anywhere near as great as is required by the Act incorporating the sewer.
Q. When you say not anywhere near, can you indicate how far?
A. Probably less than 10 feet. It does not comply with the provisions as to the distance out into the channel either.
Q. There is even a suspicion that they do not live up to their stipulation?
A. This does not become operative to their benefit until they do. They will not get the benefit of this agreement until they do.
Q. Now, in your opinion, Professor, should the effluent from the Bronx Valley Sewer be required to be of as high a character or of a lower character or of the same character as that from the Passaic Valley Sewer?
A. I think it ought to be at least as good.
3070 Q. Ought it not to be better?
A. It would be much better if it were better.
Q. Well, is not a better effluent required from a sewer discharged at that point than from a sewer discharged as the Passaic Valley sewer is proposed to be discharged?
A. The agreement does not require any better effluent.
Q. I did not ask you that.
A. What do you mean by "required?"
Q. Required by proper practice by straight sanitary practice?
A. For some reasons it ought to be better; for other reasons it need not be better.
Q. Give us the reasons for which in your judgment the effluent should be better?
A. The reason is that in my opinion the character of the waters there already is better than it is at Robbins Reef.
Q. Therefore the effluent will be better?
A. Therefore the effluent should be better in order to produce a less degradation of character. On the other hand the use of the waters will be far less than is the case at Robbins Reef. Therefore, the seriousness of the same pollution will not be as great at the Bronx Valley as at Robbins Reef. Probably twenty times the number of people will be affected by the character of the water at Robbins Reef as the number affected by the character of the waters at the Bronx Valley outlet.
Q. Then if you were discharging an effluent from a sewage disposal works at Paterson, you would require a much less thoroughly purified effluent than you would at Newark, would you?
A. I do not think that follows from the other at all.
Q. Are there not less people at Paterson?

A. Yes, less people at Paterson.
Q. Is not the water purer at Paterson?
A. Naturally it is, yes.
Q. What is the injury done by the pollution of the water in the Bay of New York or the Hudson River?
3071 A. Do you wish me to go through those effects of sewage pollution again?
Q. Briefly?
A. I will turn to it and read it.
Q. No, I do not want you to read it; I want you to give it again?
A. I can give it over again, but I cannot improve on that one.
Q. Will the polluting material discharged at the Bronx Valley sewer outlet be discharged in the ocean as quickly as the effluent from the Passaic Valley sewer discharged at Robbins Reef?
A. Probably not.
Q. Will the number of people to be affected by the discharge of polluting matter at the Bronx Valley outlet be greater or less than those affected by the discharging of the Passaic Valley outlet of an equal amount of sewage?
A. I stated already that I thought there would be many times the number of people, affected by the Passaic Valley outlet as by the Bronx Valley outlet.
Q. Will you tell me how?
A. Because of the greater use of the waters of the Lower Bay than of the waters of the Hudson in the vicinity of the Bronx Valley outlet.
Q. And the discharge of the sewage at the Bronx Valley sewer, will not pollute the water in the lower Bay?
A. It will somewhat, yes, but the field of its maximum influence will not extend down to the Lower Bay.
Q. How far will it extend?
A. It is not a definite line. It will be indefinite in extent. It will grow less harmful the farther it recedes from the point of outlet.
Q. Where will it cease to operate?
A. What do you mean by "cease"?
3072 Q. It grows more indistinct and I suppose it ceases finally?
A. Perhaps so.
Q It is a radiant force, is it not?
A. Why, it diverges from that point. It grows better up and down stream from that point. Just where you would use the word "cease," I do not know. If you will indicate what percent of influence it might be, possibly I could.
Q. It would not do any good if I gave the percent?
A. I could not tell even then without a good deal of study.
Q. What I want to get at is why you say the discharge at the Passaic Valley outlet will affect more people than the discharge at the Bronx Valley outlet?
A. Because the field of its influence has its center somewhere near the outlet itself.
Q. How far does it extend?
A. Probably somewhere below the outlet itself, owing to the fact

of the water discharged making the downward southerly flow in excess of the northerly flow. That field is a graded one, and the influence would be most intense at the center of that field, and it would gradually diminish in severity toward the upper and lower edges.

Q. Where will the influence be practically imperceptible in your judgment, how far down this discharge?

A. I should say from a sewer of that size and with that population, it would be practically insensible 10 miles below and perhaps 8 or 10 miles above.

Q. And from the Bronx Valley outlet, how far will the influences be felt?

A. I should say substantially using the same quantity of pollution as a measure of presumable influence, I should say certainly twice as far, and probably further than that.

Q. Twice as far as what?

A. As the radius of the distance of the influence of the Bronx Valley sewer.

Q. It would reach down pretty well along New York and New Jersey, Jersey City?

A. It would reach pretty well up above New York.

3073 Q. What?

A. It would reach pretty well up above New York.

Q. How far would it reach down in the direction of New York?

A. I am speaking of the Passaic Valley.

Q. I am speaking of the Bronx?

A. You asked me about the Passaic Valley last.

Q. I am asking you about the Bronx now?

A. I should say that would extend down somewhere in to the built up portion of the City of Manhattan Island.

Q. Would you think that it would be safer to discharge the same character of effluent of the same amount at the Bronx outlet than it would be at the Passaic Valley outlet?

A. Well, I did not say the same amount. I am taking account of the difference in amount.

Q. I ask you whether discharging the same amount of the same character of effluent, whether it would be safer to discharge it at the Bronx outlet than it would at the Passaic Valley outlet?

A. I do not think there would be a great deal of difference, if the handling were the same, and the character of the sewage were the same, and the manner of disposing of it were the same.

Q. Is there the same action of the tides at the Bronx Valley outlet as there is at Robbins Reef?

A. The same kind of action, but not the same extent of action.

Q. In which direction will the sewage discharge from the Bronx Valley sewer tend?

A. You mean tend to flow?

Q. Yes.

A. I do not know what you mean by the word "tend."

Q. Tend to flow?

A. It will tend to flow up and it will tend to flow down.

Q. Why will it flow up?

A. For the same reason that it goes up part of the time when discharged at the Passaic Valley outlet. It goes up during the flood tide.

Q. Which would be the greater flow, up or down?

3074 A. The ebb will be somewhat greater, slightly greater.

Q. Only slightly greater?

A. Very appreciably greater, at freshet time, but at the most critical times in the summer months, the warm months, there is not a great deal of difference.

Q. And it will therefore be borne up and down in front of the shore of New Jersey, for some length of time?

A. Yes. Part of the time it will flow up and part of the time it will flow down.

Q. Oscillating back and forth along the fronts of New York and Jersey City?

A. Yes.

Q. And you think that that effluent can safely be of the same character as that discharged at Robbins Reef, do you?

A. I did not say that at all.

Q. If the amount was the same?

A. If the amount was the same, I said the influences would be the same. I did not say you could safely discharge it. I did not say ever that it could be safely discharged.

Q. I ask you if it could be discharged as safely, with as little injurious effect at the Bronx Valley outlet as at the Passaic Valley outlet?

A. I repeat my answer, that discharging the same quantity of sewage, the same quality of sewage in the same manner, then I think one can be as safely discharged as the other, but I do not think either one can be safely discharged.

Q. I am simply asking you to compare the two. I did not ask you to state whether it would be safe or not. That is another volunteered statement. What constitutes, in your judgment, the safety of a sewage discharge into the waters of New York Bay?

A. Esthetic appearance, odors, turbidity, reduction of the dissolved oxygen, injury to water life, plant life and fish life and shell fish, injury to bathing.

Q. Those are the injurious effects that you have reference to, when you say that you do not think either of them could be discharged safely?

A. Yes.

3075 Q. Any others?

A. Yes.

Q. What?

A. The risk of danger from infected shores and docks, by reason of flies and other means of communication.

Q. And that arises from organic matter carried to and located upon the shores?

A. Yes, mainly.

Q. You think that injury is as great from sewage discharged

at Robbins Reef as from sewage discharged at the Bronx Valley outlet?

A. With the same quantity and conditions, yes.

Q. Now, you have testified as to the effect of the proposed discharge from the Passaic Valley Sewer upon the bathing establishments in New York Bay. Which ones do you refer to, which bathing establishments?

A. I referred in general to the public bath houses and bathing beaches.

Q. Take up the public bath houses, where are they located?

A. Well, there are two on the North River.

Q. Can you locate them any more definitely than on the North River?

A. They are scattered. No, I cannot locate them more definitely.

Q. Have you ever examined them?

A. Yes, I have examined one of them.

Q. How far was it from the mouth of a sewer?

A. I cannot speak definitely. I should say in the neighborhood of 100 yards.

Q. Were you concerned in making tests of the discharge of sewage from that particular sewer into what particular bathing establishment?

A. No, I was not concerned in that test.

Q. Do you know whether there was a test?

A. Yes, there was.

Q. Do you know whether it demonstrated the flow of the sewage into that bathing establishment.

A. I think that it demonstrated the flow towards it. I am not sure just whether it went into it or not.

Q. Do you think that bathing establishment would be injuriously affected by the discharge from the Passaic Valley sewer?

A. I do.

Q. Do you think it is a fit bathing establishment and that it ought to be tolerated as it is now?

A. It certainly ought not to be tolerated when the tide is
3076 moving from the sewer outlet down to the bathing establishment. When it is moving the other way it would be tolerable, if the waters of the river in general were safe for bathing.

Q. How far is it from a sewer outlet below?

A. I cannot speak with definiteness, but as I recall a good deal farther than to the sewer above it.

Q. How far is it to the bulkhead?

A. You mean the bathing establishment or the sewer?

Q. The bathing establishment?

A. Well, it extends up to the bulkhead.

Q. Up to the bulkhead?

A. Yes. I think it is the bulkhead there. It may be the pier line there, I do not know. I think it is the bulkhead.

Q. And is or is it not within the limits of the most polluted part of the waters of New York Bay?

A. Well, it is hard to say which is the most polluted. It is probably polluted enough, I admit that.

Q. It is very doubtful whether the discharge of sewage at Robbins Reef will have any effect on it, is it not?

A. I do not think that follows. The sewer situated nearest to it is above it, and the bathing establishment receives its worst injury from that sewer on the ebb tide. Now, during flood tide, the bathing establishment would be comparatively safe, if the waters of the rivers themselves were safe. But if they are also polluted, then the bathing establishment would be put out of business both by the ebb tide and the flood tide.

Q. Where is there another bathing establishment that you know of?

A. Well, there is at least one in the East River.

Q. Whereabouts?

A. I think that is about opposite to the East River. I cannot tell you just the location. It is below 30th or 34th Street, and I think there are two over there.

Q. How far away, are there sewer outlets from those bathing establishments?

A. They are farther away. Those bathing establishments are located more remote from the sewer outlet.

Q. Was there any color test to determine whether sewage reaches them, within your knowledge?

3077 A. I cannot say whether the color test was applied to those bathing establishments or not.

Q. Did you see any color test applied to any bathing establishment?

A. I did not see any of them done.

Q. Is the water at the East River at the bathing establishments that you have last referred to unpolluted?

A. I should not call it unpolluted.

Q. To what extent is it polluted?

A. I think it is better than the one on the North River, when the tide is on the ebb.

Q. What effect do you think the discharge of the sewage at Robbins Reef will have on that water at those bathing houses?

A. Whatever it is, will be to render it less suitable for bathing than it is now.

Q. Do you think that it is suitable for bathing now?

A. I do not think it is.

Q. Do you think that any of the waters around the Island of Manhattan or along the Brooklyn shore are fit to be bathed in at the present time?

A. Well, there are probably points where it would be safe to bathe in them with care.

Q. What is the care that you refer to?

A. Care about taking the water into one's mouth.

Q. Not to swallow the water?

A. Yes.

Q. And the danger from that is taking in pathogenic intestinal germs?

A. That would be harmful clearly.

Q. Is that the danger of taking it into the mouth?

A. Yes.

Q. Any other danger?

A. Yes, danger of choking too.

Q. Choking from what, the water or the solids?

A. The salt water.

Q. Well, that has nothing to do with the sewage, has it?

A. No, you wanted a list of dangers and I am giving them to you.

Q. Now, if that sewage, which now discharges into New York Harbor—using the word "harbor" now in its broadest sense—were first treated in the way that is specifically described in Ex-
2078 hibit No. 135, being the stipulation between the United States Government and the State of New Jersey, would or would not the general condition of the waters of the harbor be improved?

A. I think they would.

Q. Much?

A. If they were all actually improved to such an extent as to fully comply with all the conditions, then I think there would be an appreciable improvement.

Q. Perhaps I do not make myself clear. If the sewage discharging into the waters of New York Harbor were all treated by the processes specifically described in this stipulation, would the waters of the harbor be in your opinion improved or not?

A. By the plant which is proposed, suggested in the agreement, forming Exhibit No. 135?

Q. Which are described in the exhibit?

A. The results are described in very definite positive terms, but the form of plant suggested to accomplish those is also described.

Q. If you prefer the word "suggested" to "described" I will substitute it. I am disposed to be exact myself.

A. I want to know whether you are referring to the positive stipulations or the suggested form of disposal treatment.

Q. The processes, not the results?

A. Yes, I think the sewage would be somewhat improved.

Q. Much improved?

A. I cannot say how much.

Q. I ask you whether it would be much improved as distinguished from some?

A. Well, how much do you mean by "much?" What percentage, what definite amount?

Q. What do you mean by "some." You say that it will be improved "some?"

A. I should say at least 25 per cent.

Q. Any more than 25 per cent.?

A. Possibly.

Q. Now, if the waters of New York Bay were not polluted at all,

and there were discharged into them, sewage treated by the processes suggested in the stipulation in question, what injury would result in your judgment to the waters?

A. I think that most, if not all of those absolute stipula-
3079 tions would be violated.

Q. They would be violated?

A. Yes.

Q. Now, you think that the oxygen in the water would be reduced to a point where it would injuriously affect major fish life?

A. I think to some extent. I cannot indicate how much it would affect it. Certainly some fish, some individual fish of some kind would be injuriously affected. What the aggregate effect would be, I cannot say.

Q. Have you attempted to determine what the reduction in the dissolved oxygen would be from the discharge of the sewage treated by the processes suggested in the stipulation?

A. No.

Q. Can you give any idea. Have you any idea of the amount of reduction?

A. In the whole large volume of water?

Q. Take the discharge of the sewage from the present population of say 750,000 inhabitants?

A. Yes, but into how large a proportion of water. How large a volume of water?

Q. Into New York Bay Water at Robbins Reef?

A. Well, you understand, of course, it would tend to reduce the oxygen consumed by a large amount in the vicinity of the sewer, and by a small amount as you went away from the sewer. How far do you go away from the sewer?

Q. I am not going to take any particular point. I am asking you to take the average?

A. I do not know what the average means in that case.

Q. All the waters of the bay?

A. That is too indefinite for me to answer.

Q. One other witness attempted to answer it.

A. That may be.

Q. Do you think that it would be more than 7 per cent?

A. That is too indefinite for me to answer.

Q. If all the sewage which is now discharged into the waters of New York Bay was an effluent after treatment by the disposal works, which effluent would comply specifically with the effluent described in the stipulations, being Complainants' Exhibit No. 135, what effect would that sewage have upon the waters of New York Bay?

A. I do not believe that I understand that question.

Q. If all the sewage discharging into the bay was purified
3080 so as to comply with the stipulation in question, would the discharge into New York Bay be injurious?

A. When you say "stipulation" do you mean the absolute requirements here, or the processes that are suggested?

Q. The absolute requirements?

A. I have already said that I know the result would be a general benefit.

Q. Do you think that it is feasible for New York City to purify its sewage to that extent?

A. I think that it is feasible, yes.

Q. All of the sewage of New York City?

A. All of the sewage of New York City.

Q. To treat it so as to comply with this stipulation?

A. I think so, by the expenditure of a proper amount of money, and proper processes and plans.

Mr. Riker: That is all.

Redirect examination by Mr. O'Sullivan:

Q. Professor Landreth, has salt or brackish or fresh water the greatest purifying powers on sewages discharged into them?

A. Fresh water.

Q. I hand you Complainants' Exhibit No. 91, and direct your attention to the tabulations for the entire year, and ask whether there is a larger measure of fresh water at Mt. St. Vincent or Robbins Reef, taking Tarrytown which is within 3 miles of Mt. St. Vincent, taking the average for the entire year in the last column?

A. There is very much more fresh water at Mt. St. Vincent.

Q. More than twice as much?

A. Yes, sir, nearly 3 times as much.

Q. Is there any difference as to whether or not it will purify more rapidly in fresh or brackish or salt water?

A. It will purify more rapidly in fresh water.

Q. Will sewage solids be precipitated more rapidly in fresh or salt or brackish water, and form sewage deposits?

A. In salt water.

Q. You were asked some questions relative to the character of the Bronx and the Passaic sewage. I ask you if you use the term "residential" in describing sewage?

3081 A. I think that I have used that term or words to that effect.

Q. What does that mean when sewage is characterized as "residential?"

A. It is residential or industrial sewage or storm water. In the case of the Bronx Valley the proportion of industrial wastes or industrial sewage will be very small. The proportion of diluting water will also be larger than in the case of the Passaic Valley.

Q. You mentioned that Paterson was at the head of the Passaic Valley trunk sewer project. That would be at the beginning of the sewer?

A. Yes.

Q. Is that a manufacturing center, or a residential center?

A. Largely manufacturing.

Q. What character of manufactures are conducted there?

A. Textile and fabric industries, industries requiring a consid-

erable amount of coloring matter,—coloring chemicals, silk mills and others.

Q. Taking those textiles, those woolen and silk mills, is there a large or small amount of organic matter in the trade wastes from these mills or factories?

A. There is some organic matter, considerable part of organic matter. There is also a good deal of chemical mineral matter.

Q. Is White Plains, which is at the end of the Bronx Valley trunk sewer, a residential or manufacturing center?

A. A residential center.

Q. How does the relative population of the Bronx Valley trunk sewer district, numbering 50,000, compare in your mind with the population of 734,396, being the census of 1910 for the Passaic Valley trunk sewer? How do these two compare in your consideration of the relative conditions of the sewages and their outfalls?

Mr. Riker: I object to it on the ground that it does not appear that there is any such population. This witness says that he does not know.

The Commissioner: Note the objection of Counsel for Defendants.

A. I have taken them into account in my answers, both on account of the much larger population of the Passaic Valley district and also on account of the addition of the large amount of industrial wastes in the sewage from that district having much greater
3082 effect than would be the case from the Bronx Valley sewer, even if discharged into identically the same conditions, as to the harbor conditions.

Q. You mentioned something about the contiguity of the disposal plants to the outfalls. What important feature is there in that in considering the questions that you have answered?

A. Well, sewage goes on in the process of decomposition while it remains in the sewer, after it leaves the disposal plant in the same way, that that same kind of material does before reaching the plant. Therefore the critical question is not alone the distance to the disposal plant, but the distance to the point of discharge into the waters of the harbor. That is five or six miles farther down the stream than the location of the disposal plant in the case of the Passaic Valley. In the case of the Bronx Valley, it would be only a short distance from the disposal plant to the outfall into the river.

Q. Does septic sewage contain more sewage solids or less sewage solids than fresh sewage.

A. It contains less.

Q. Due to what?

A. Due to the fact that the progressive anærobic decomposition has gone forward and has accomplished in part the rectification of a portion of the solid matter. In other words some of the solids have been converted into liquids.

Q. You were asked some questions relative to the tidal range in our harbor. Will you look at the first page of Complainants' Exhibit No. 91 and see what the difference in the tidal ranges between the upper bay and Throgs Neck are?

A. The average tidal range at the upper end is 4.4 feet. The average tidal range in the East River near Throgs Neck is 7.1 feet.

Q. Do the phases of the moon influence the tidal range?

A. Yes, and also the location of the point of the measurement, the point of the tidal gauge.

Q. Are you familiar with terms like mean, spring, neap
3083 and great tropic, as applied to the ranges of tides? (No answer.)

Adjourned to September 12, 1912, at 10:30 A. M.

Supreme Court of the United States, October Term, 1911.

THE PEOPLE OF THE STATE OF NEW YORK, Complainants,
against
STATE OF NEW JERSEY and PASSAIC VALLEY SEWERAGE COMMISSIONERS, Defendants.

CORPORATION COUNSEL'S OFFICE,
NEW YORK CITY, September 12th, 1912—10:30 o'clock a. m.

Before James D. Maher, Esq., Commissioner.

Appearances:

Dr. William J. O'Sullivan, Special Counsel for the People of the State of New York, Complainants.

Adrian Riker, Esq., of Counsel for the Passaic Valley Sewerage Commissioners, Defendants.

Met pursuant to adjournment.

OLIN H. LANDRETH, a witness called on behalf of the Complainants, recalled for further examination, testified as follows:

3084 Redirect examination by Mr. O'Sullivan (resumed):

Q. Professor Landreth, are you familiar with such terms when applied to ranges of the tide as mean, spring, neap, great tropic?

A. Yes, sir.

Q. What do they mean?

A. Mean tide means the mean or average between the highest range of tide and the lowest range of tide, when applied to the word "range". When applied to the height of tide, or elavation of the tide, it means corresponding to the average or mean between the high spring tide or the high tide and the lowest low tide or neap tide. The term "mean tide" is used to give a general idea of the tidal phenomena whether it is applied to tidal elevation or tidal range, whereas the extremes which take place twice a month vary from a large value down to a much smaller value. A large value spring tide is due to the concurrent effect of the sun and moon together. The low value of the neap tide is due to the discordant effects or the counteractive

effect of the sun as against the moon and the neap tide represents the difference between the moon's effect, which is the greater, and the sun's effect, which is the less. When those influences are so arranged as to operate concurrently, then they produce the sum of these effects, and that is called the spring tide. When they operate to produce the difference, they produce the minimum effect, and they are called neap tides, and mean is the average or mean between those two extremes. There is not only a difference due to the sun and the moon, but there is also a difference due to the different position of the moon in two respects, both as to the moon's distance from the earth and as to the moon's position with regard to the equator, whether it is near to or remote from a certain geographical point. The tidal effect of the moon is greatest when the moon is nearest to the earth, and when the moon is said to be in perigee. The least effect, other things being equal is when the sun is farthest from the earth, or said to be in apogee. So the perigee tide relates to the tide as recognizing the differences in the distances from the earth, and indicates the
3085 effect when the moon is nearest to the earth, and the apogee tide is the corresponding value when the moon is farthest from the earth. Similarly with regard to the position of the moon north or south of the equator, giving rise to tropical differences. When the moon is at the part of its path, most remote from the equator, on the northerly side of the equator, it is said to be in the northern tropic. When it is most remote from the equator on the southerly side it is said to be on the southern tropic. In the northern hemisphere a northern tropical tide will have a greater effect than when the moon is at the extreme or most remote position from that than the southern tropic. So we have three different causes tending to produce differences in tidal values. We have, first, the concurrent or discordance of the sun and moon. We have, second, the differences in distances of the moon away from the earth, and we have, third, the differences in distances of the moon away from a particular port or point, due to its being north or south of the equator.

Q. Have you defined what is meant by the term "great tropic" as applied to tidal ranges?

A. "Great tropic"—it corresponds with the value when the moon is at its extreme distance north or south of the equator, and is also to be accompanied by the cardinal term north or south, north tropic or south tropic.

Q. And has the height of the tide—what influence has it, or what does it mean?

A. The influence of each of these three conditions, the relations of the moon and the sun is the first cause. The distance from the moon away from the earth is the second cause, and the fact as to whether the moon is in the same hemisphere, or the opposite hemisphere, determines the height of the tide. It also determines the condition under which the tide ranges, and therefore determines the range of the tide.

Q. And in some ports is there a considerable difference in the height of those tides?

3086 A. Oh, yes. At any particular port there are not only—there are periodic differences, which are affected by all three

forces, but there are also constant geographical influences which tend to make the tide at a particular point higher than at some other point, or very near. For example, right here in our New York Harbor, Governors Island is only a few miles from Throgs Neck, and still the mean range of tide at Throgs Neck is probably three feet more than it is at Governors Island.

Q. Higher?

A. No, the range is larger. The range at Governors Island is something like about 4½ feet. The range at Throgs Neck, the mean range at Throgs Neck is over 7 feet. That, however, is a local geographical influence arising from the configuration of the shore line of the harbor and affecting the tidal water, the propagation of the tide as it comes in.

Q. Does that affect the currents in the incoming tide and the outgoing tide?

A. The range of tide affects the current mainly so far as the velocity is concerned. The position of the currents, their direction, the set, and all those things are mainly determined by local matters of configuration and forms of the channels.

Q. The contour of the harbor?

A. The contour of the harbor has an influence, diverting islands or shores. For example, even an artificial difference may have an effect such as the Ambrose Channel, which has changed quite appreciably the direction——

Q. You mean the Ambrose Channel where?

A. Through the bar at the mouth of New York Harbor, towards the Lower Bay. That channel has had the effect of steering the current in quite a different direction from what it used to flow. That channel is approximately 35 or 40 feet in depth, whereas the depth of the water on the bar is only a fraction of that, and the presence of that channel of a very appreciable width and considerable depth, has afforded a tidal channel, an artificial tidal channel, which causes the incoming tide to move in the direction of the line of that channel.

Q. Is that channel shown on Complainants' Exhibit No. 171A?

A. Yes.

3087 Q. What influence do the tidal conditions that you have just now described in relation to Ambrose Channel have upon the pollution of the harbor and its distribution?

A. Well, they disturb mainly the direction of the incoming or flood tide, to some extent, that is, the difference which affects the pollution. The outgoing or ebb tide is also in some measure influenced artificially by the channel, but that does not materially affect the pollution, but on the incoming or flood tide, the natural direction anyway is by this channel. It is emphasized that the water entering through the straits between Sandy Hook and Coney Island is shot in directly towards the northwest.

Q. Toward what shore?

A. Toward the southeast shore of States Island, between South Beach and Great Kills,—Fort Wadsworth and Great Kills. Now, the construction of the Ambrose Channel emphasized the course of that current and gives us a concentrated tidal current moving di-

rectly towards that, so that the effect of Ambrose Channel is to increase the force of the current that throws the returning tidal water carrying pollution up on to the southeast shore of Staten Island.

Q. Between what points?

A. Between Fort Wadsworth and Great Kills. Middle Beach is just about in line with the direction of Ambrose Channel prolonged. The line strikes a little south of Middle Beach.

Q. Do any of the float observations made during your Commissionership in the New York Bay Pollution Commission, illustrate that direction of the sewage pollution towards the shores of Staten Island?

A. Well, while I was a member of the New York Bay Pollution Commission, we made no float observations, but we did secure other information by taking the sworn testimony of pilots as to the set of the current, and that testimony indicated to that commission that the flood tide returning struck the southeast shore of Staten Island in this general direction, extending from Fort Wadsworth toward Princess Bay, especially as far as the Kills. It is to be noted that on the ebb tide, that is the outgoing tide, water is pour-
3088 ing out of two outlets, the Narrows pointing nearly south, or a little east of south and coming out of the Kills and Raritan Bay, nearly east. Those two outgoing currents unite, somewhere near the—a little south of the westerly end of Ambrose Channel, and just north of Sandy Hook. On the return, however, of the tide, that is on the flood tide, a single current of water between Sandy Hook and Coney Island enters, and it is obliged to divide to fill the low water tidal prism, both in New York Harbor and in Raritan Bay and the Kills. Consequently, there is a division of the tide, a portion flowing up the Narrows and filling New York Bay and adjacent waters, and the other flowing west into the Raritan Bay and supplying the Arthur Kill, and the other estuaries in that neighborhood. Between those two divergent branches lies this southeast shore of Staten Island, and as a consequence the returning tidal water, which is largely original bay water, bringing back a large portion of the organic matter which it took out, is thrown on this southeast shore of Staten Island. That influence on pollution comes from this tidal phenomena, and it is emphasized and accentuated by the artificial development of Ambrose Channel, which tends to shoot the current more strongly even against the southeast shore.

Q. Of what?

A. Staten Island.

Q. You were a member of the first Metropolitan Sewerage Commission?

A. Yes, sir.

Q. Did any float observations conducted by that commission illustrate the matters that you have just now testified to?

A. Illustrated and proved them.

Q. I show you Complainants' Exhibit No. 10 and Complainants' Exhibit No. 4, and Complainants' Exhibit No. 9, and ask if you can find on those exhibits matter that tends to show the things that you have just testified to relative to the pollution?

A. On Complainants' Exhibit No. 10, which is a chart of float observations made by Metropolitan Sewerage Commission No. 1, there is the path of a float placed in the Bay just north of
3089 Robbins Reef at 10:30 A. M. It flowed south, following very closely the northeast shore of Staten Island, passing out the Narrows very near to Fort Wadsworth. That is to say 5/6ths of the way across towards Fort Wadsworth, or the Staten Island shore, then moving out into the Lower Bay, and then, after the tide turned, it turned toward the west and moved in the direction of McKeevesport or South Amboy, and at that time it was taken out of the water at 5 o'clock. Our observations were not conducted during the night time, and we were obliged to remove the floats from the water as soon as we were unable to see them by daylight. That float was run on July 9th, 1907.

On Complainants' Exhibit No. 4 in this case, we have the record of a float which was run on February 23rd, 1907. This float was put in the water especially for the purpose of discovering the direction of the ebb tide from a point starting on the South Brooklyn shore. This float ran ashore twice, and was each time taken out into the water and passed down through the Narrows, crossing the center line of the Narrows just about midway between Fort Wadsworth and Fort Hamilton. It moved southerly until it entered the Lower Bay opposite Quarantine. It then turned towards the east and at the turning of the tide it was a little east of a line from Sandy Hook to Coney Island. On the change of the tide when flood tide occurred, the float ran west by southwest in the direction of South Amboy.

Mr. Riker: You do not think this is redirect, do you, doctor?

Mr. O'Sullivan: I certainly do, Mr. Riker. You went very deeply into the question of tidal currents.

Q. Proceed, Professor, make it brief. What is the next?

A. After the turn of the tide the float ran several miles west by southwest and was taken out of the water at 5.45.

Q. When it was taken out in what direction was it faced?

A. It was moving westerly. It had just turned towards the
3090 northwest direction and was pointed toward Middle Beach on the southeast shore of Staten Island.

On June 23rd, 1907, a float was placed in the water just east of Robbins Reef at 11:10 A. M. It followed down the southeast shore of Staten Island, passing through the Narrows, very near to Fort Wadsworth, just as before, about 5/6ths of the distance across the Narrows from Fort Hamilton towards Fort Wadsworth, and followed directly along the southeast shore, keeping close to the shore, and continued to do so until 2:50, at which time it was taken out of the water.

Q. When it was taken out of the water in which direction was it going?

A. Moving southwest.

Q. Near what shore?

A. It was very near to the southeast shore of Staten Island, and

not far from Middle Beach and pointed still in the direction of Great Kills.

Q. The tidal ranges that you gave for the Upper Bay as 4.4 and at Throgs Neck as 7.1, are those the mean ranges, or under what other term would they come, that you have already described?

A. Those are mean ranges. The extreme ranges that I referred to as the spring tide and the neap tide would be even greater than that. For example, at Governors Island the maximum range, that is that which occurs at spring tide is 5.3 feet. The minimum range, which occurs at neap tide, is 3.4 feet, whereas the mean range is the average of these extremes, or at least the average of the values between those extremes 4.4 feet.

At Throgs Neck on the other hand, the extreme range is 8.5 feet. That is to say the range between high and low tide, at a certain phase of the moon is 8.5 feet. At the opposite phase of the moon it is 5.7 feet, and the mean of the values between the two extremes is 7.2 feet, as testified to by me yesterday.

Q. Now, in addition to the phases of the moon and the other factors that operate in giving unusually high tides, do winds have any operation in that direction?

A. Yes. Their influence however is irregular and it cannot
3091 be predicted. It is local and temporary in character, but they very frequently aggravate or modify the influences of the present and regular tidal influences. For example when a southeasterly wind occurs on the flood tide, it invariably produces a higher elevation of tide in New York Bay, and on the contrary when a northwest wind occurs at ebb tide, it produces a lower flow of water in New York Bay.

Q. In talking about low water, do you recognize such terms as mean low water, mean lower water and mean low low water spring?

A. Yes.

Q. What do those terms mean?

A. They refer to the elevation of the surface of the water at low tide, at spring tide, also at low tide or neap tide, and also the mean of the values between the extremes.

Q. In your examination on the ulva latissima, you confined your testimony to the conditions found in Belfast lough. Do those conditions obtain in other ports?

A. The occurrence of the ulva latissima obtains in other ports particularly some of the ports of the Mediterranean, Naples and some of the other Italian ports. It also has occurred in other Irish ports, and I think also some of the Scotch estuaries, which I do not just now recall. It is a plant, however, a water plant, whose existence depends on two things. The existence of suitable conditions and the planting of the spores, and it is a plant which is able to operate between a not very narrow range of conditions. It is as yet not a widely distributed plant, however.

Q. In your examination you replied to Mr. Riker that you detected the odor of sulphuretted hydrogen. Is there any popular way of describing that odor?

A. Why, it resembles more than anything else, the odor of rotten eggs.

Q. I call your attention to Complainants' Exhibit No. 173 and the third column of figures there, over which are the symbols H_2S and I ask you what the symbols H_2S means?

A. H_2S is the chemical symbol for sulphuretted hydrogen, whose components are hydrogen and sulphur.

3092 Q. Does that exhibit show that you detected the odor of sulphuretted hydrogen or hydrogen sulphide or H_2S as you have described it?

A. Yes, these odors were recorded at each of those stations.

Q. And tabulated?

A. And tabulated by me in this table. Thus, in the Hudson River district, there were 32 instances where the occurrence of sulphuretted hydrogen was observed in the muds taken up from the bottom. In the Upper Bay there were 63 instances where the deposit gave the odor of sulphuretted hydrogen. In Newark Bay, there were 65. In all, out of 551 samples in the whole 13 districts 220 revealed the presence of hydrogen sulphide odors.

Q. You were asked yesterday as to the population of New York City. Has New York City got a floating population?

A. Oh, yes, in addition to its regular recorded population.

Q. What do you mean by floating population?

A. Transient population, traveling people, and people who come here for transient periods, and who are not recorded in the population in the census.

Q. Have you made any estimate giving an approximate idea of the size of that floating population per day?

A. It varies widely with different seasons of the year. It is getting to be more nearly uniform, and from figures which I have had occasion to inspect, I should estimate that it would average at least 100,000 people, possibly would go as high as 150,000 people.

Q. Would you put it at 5 times as big as that?

A. No, it might be.

Q. Well, it is.

A. When I give the 15,000, I am not speaking of the population which represents the people, doing business in the city. I am confining my estimate to the number of people who come here at irregular periods for irregular purposes. There is another large percentage that properly ought to be classed under the term "transient population" who live outside and do business in New York.

Q. Where do they sleep, most of those?

A. Some in Westchester County, some in Long Island, some in Jersey, all about.

3093 Q. In reply to questions relating to turbidity, Professor Landreth, you stated that it excluded sunlight and interfered with the esthetic value of the waters. I ask you if the exclusion of sunlight operates otherwise than from an esthetic standpoint?

A. Yes, it operates to prevent, to inhibit the development of water vegetation, and thereby removes from the water, its purifying influ-

ences or organisms, and also removes from the water, the supply of animal food on which the water fauna depend.

Q. Is turbidity due to other causes than the ones that you gave yesterday, such as spent liquors and trade wastes, and if so, what will that turbidity occasion as far as the plankton and the natural purifying agencies are concerned?

A. I intended to include in the term "sewage" the whole production of a sewer, which in the case of some territories, consists mainly of domestic sewage, and others combined domestic sewage and industrial wastes. In the case where the industrial wastes are considerable, the addition of these wastes to the sewage is not a substitution, but an addition. There is just as much domestic sewage as the population indicates, and in addition to that, not in substitution, but in addition to it, there is the additional amount of trade waste. Now, if this trade waste is in suspension, as a larger proportion will be rather than in solution, or if being in solution it is highly colored, then it tends, if in suspension, it tends to increase the turbidity of the waters into which it is discharged, and that increase in turbidity not only increases the cutting off of sunlight, but in many instances the trade wastes themselves are of an antiseptic nature. They are frequently of a chemical origin and nature, and tend to poison or disinfect the waters by their antiseptic or injurious effect. They tend to destroy the water life from quite a different cause than cutting off the sunlight, and in the destruction of that, of course, they tend to increase the precipitant material by reason of the organic life thus added to the deposited material. That is not a very large element, but whatever it is, it is in addition to the total aggregate of sludge deposit on the bottom.

3094 Q. Are these spent liquors in trade wastes very acid?

A. In many cases they are. In some cases they are alkaline. Their character depends on the nature of the operation carried on at the industrial establishment, and on the nature of the waste itself.

Q. Do they act as precipitants?

A. In many cases they act as precipitants and tend to throw down other matters contained in the waters. For example, a district in which the treatment of iron, especially pickling iron—and a preparation for galvanizing or any iron treatment, any iron treatment that requires the removal of rust, that will almost inevitably discharge acid iron wastes into the waters.

Q. Are there factories that discharge such wastes now in operation along the Passaic water shed?

A. Yes.

Q. Discharging into the Passaic River?

A. Yes. Those factories which operate in the direction of tanning, and also those which operate in the direction of pulp making all discharge acids, at least the pulp making industry discharge acids in their wastes. The tanning operations on the contrary are generally productive of alkaline wastes, which will also become precipitants, since they carry lime. There we have our two common precipitants for organic matter, lime and sulphate of iron. Now, each of these

may be formed in the waters by the discharge of either lime wastes or sulphate or iron wastes and usually the acid that is used for iron treatment is sulphuric acid.

Q. Commonly called?

A. Blue vitriol, commonly called copperas. Copperas is sulphate of iron. It forms therefore by combination of the sulphuric acid with the iron, this precipitant which is artificially used in the works and lime is also used as a precipitant. Therefore as to whether the matter is acid or alkaline does not always determine whether it will be a precipitating compound or not.

Q. Now, in your answers on effluvium nuisances, I do not recall your mentioning the particular gas, the name of it, that is
3095 most objectionable in these effluvium nuisances?

A. I think hydrogen sulphide is the most general, the most common, and that is the one that not only gives rise to the odorous conditions but also the one that does most financial harm in the way of injuring paint, turning white paint, or paint containing white paint, dark, black, yellow and black.

Q. And in that way does it injure property?

A. It does.

Mr. O'Sullivan: That is all.

Recross-examination by Mr. Riker:

Q. Now, Professor, I asked you about your observations of effluvium which you recognized as the sulphuretted hydrogen?

A. Yes, sir.

Q. Taking exhibit No. 173, did you make those observations personally?

A. No, I did not.

Q. Did you make any of them yourself?

A. No, not personally.

Q. I asked you as you may recall whether in your passing along the points of the river along the shores of the river, you had observed at any places, this odor of sulphuretted hydrogen. These observations that are recorded in exhibit No. 173, as you understand it were from the muds dredged from the bottom?

A. Yes, sir.

Q. They had nothing to do with the odors on the surface of the water?

A. No, sir, except that they were the original causes of the odors on the surface when they became severe enough to pass up and escape in the air.

Q. You believe you know that as a fact?

A. Yes.

Q. You did not take the odors of any of the deposits from the bottom?

A. No.

Q. You do not know what other sources of sulphuretted hydrogen there may have been at those points?

A. I know that there were no other sources of sulphuretted hydro-

gen at those points other than the wastes on the bottom and on the unexposed portions of the dock, but in those instances, in almost every case we saw evidences of the gas coming to the surface,
3096 escaping gas bubbles, and frequently the appearance on the surface of floating particles.

Q. How many were there in those instances?

A. I have observed that in many instances. Just the number I mentioned to you I should roughly say in two thirds of them.

Q. How many in number is two thirds of the instances that you have mentioned, two?

A. Well, I do not remember now just how many I mentioned to you. I have seen in the bay here forty instances I should think, where I have seen particles of solid matter coming to the surface, breaking up and usually accompanied by bubbles of gas.

Q. Do you know whether they came from the bottom?

A. No, I do not know, they may have come from a skyscraper. I do not know whether they came from the bottom of the harbor. I know they came up through the harbor.

Q. If the solid matter was held in suspension, would it not act in the same way?

A. No.

Q. It needs to be deposited at the bottom before it can act in that way?

A. Before it can act in that way, or in some mass of putrefying organic matter.

Q. What is the condition of the waters in the Lower Bay?

A. Do you mean at the present time?

Q. Yes.

A. What phase of the tide?

Q. Any phase of the tide, all phases?

A. It is different at different times.

Q. Is it good or bad?

A. It is not good.

Q. What is the average percentage of dissolved oxygen in the waters of the Lower Bay?

A. That differs.

Q. Have you not seen a chart giving it?

A. Yes.

Q. Well, do you remember what it is?

A. Yes, I know generally.

Q. What is it?

A. It differs; perhaps the general value would be about 70 per cent.

3097 Q. In the Lower Bay?

A. The Lower Bay.

Q. I am asking you about the lower Bay?

A. Beg pardon in the Lower Bay it is higher.

Q. Well, how high?

A. Why, that is probably 10 per cent. higher.

Q. Yes, and more than that, isn't it?

A. At times, yes.

Q. Does it not average a good deal more than that?

A. Possibly it may a little more than that.

Q. Do not the figures of your commission show that it averages a good deal more than that?

A. It averages somewhat more than that, yes, sir.

Q. And is that the water that is carried on the tides to the South eastern shores of Staten Island?

A. Yes.

Q. What harm does it do?

A. Well, so far as the oxygen determination is concerned, it has robbed the water of just that much of its purifying agency, but that same water has also carried along in the form of dissolved matter and also some suspended matter, matter which is harmful, harmful sources of pollution. For example, if the typhoid bacilli are carried out and then brought back, they are in some measure deposited or thrown against the southeastern shore of Staten Island.

Q. If there are typhoid bacilli in the water, and they are carried to the shore, they are deposited there in your opinion?

A. Yes, and that is entirely without any reference to the oxygen content of the waters.

Q. How far is that southeastern shore from Robbins Reef?

A. 5 or 6 miles.

Q. How far is it from the mouth of the Hudson?

A. The mouth of the Hudson, speaking of the Hudson at the Battery?

Q. I mean the cross section which has been shown by exhibits here as the mouth of the Hudson, where the percentage of dissolved oxygen is 55, do you remember that?

A. Yes.

Q. How far is it from there?

A. Probably 10 miles.

Q. Do you think it is 4 miles from the mouth of the Hudson to Robbins Reef?

A. Probably not quite.

3098 Q. Well, how far is it?

A. Your point, the southeastern shore is rather indefinite.

Q. Using the same point that was referred to as 6 miles from Robbins Reef. How far is that point?

A. I should say about 9 miles.

Q. You think it is about 3 miles from the mouth of the Hudson to Robbins Reef?

A. Somewhere around that, yes.

Q. How far is the point that you had in mind in answer to the question as to the distance from Robbins Reef to the southeastern shore of Staten Island, from the mouth of the East River?

A. About the same distance.

Q. Do you remember what the average oxygen content is at the mouth of the East River as shown by the exhibits that have been produced here?

A. I do not carry it in my mind, but it is somewhere around 60 per cent.

Q. If I mention 55, does that refresh your memory?
A. Yes.
Q. It is 55, is it not?
A. Somewhere about that, yes.
Q. Now, taking the guaranteed results in Complainants' Exhibit No. 135 and in Complainants' Exhibit No. 177, bearing them in mind, in your judgment would the effluent which would produce those results contain more or less than 90 per cent. of putrescible matter on an absolute scale?

Mr. O'Sullivan: I object to that question. It is not proper recross examination. I have not gone into the effluent and stipulations.

Mr. Riker: I overlooked this and take the liberty of putting it in now as additional.

The Commissioner: Note the objection of Counsel for Complainants.

Q. Answer the question.
A. I could not speak definitely. I should probably think it would be less than 90 per cent.
Q. Less than 90 per cent. in order to produce those results?
A. Probably.
Q. Are not you quite sure that it would be?
A. Well, concerning a problem so problematical as to the results of the operation of that plant——

Q. I am not talking about any special plant. I am talking
3099 about the effluent.

A. I should think very likely it would be less than 90 per cent. I am not sure though.
Q. Did not you say you thought that effluent was about equivalent to river water?
A. Substantially and of ordinary river purity.
Q. You meant a polluted river?
A. I meant a river water exposed to the ordinary and usual measure of pollution. Those are the terms in which the question was put to me, I think.
Q. It is my recollection that you were asked if it was distilled water and your answer was that it corresponded to ordinary river water. Am I not right?
A. Yes.
Q. What kind of river water, did you refer to?
A. I mean river water, not in its primitive condition, but in its ordinary state just as it receives the general waste of a population, not densely polluted or primatively pure.
Q. You do not mean river water such as we have at Newark in the Passaic?
A. No.
Q. Well, do you mean water that is potable?
A. No, not necessarily. It certainly would not be *it if* were anywhere about here.
Q. I am asking you whether this effluent which would produce the results guaranteed in both the stipulations that are now offered in evidence would be of a potable character?

A. I should think not necessarily.

Q. Well, why not?

A. Because they might be far from being potable, far more impure than a potable effluent and still accomplish those results.

Q. Still it would be equivalent to river water, not specially polluted?

A. Yes.

Q. Well, do you think that river water especially polluted contains as much as 90 per cent. of the putrescible matter on absolute scale?

A. No, not the whole content of the water certainly.

Q. You do not think so?

A. If I understand you rightly, you asked whether or not
3100 I think the water contains 90 per cent. of organic matter. Then, of course, it does not.

Q. I was asking you whether the effluent which is prescribed and guaranteed to produce certain results can produce those results if it has as high as 90 per cent. of putrescible matter in it?

A. You understand, of course, that the 90 per cent. relates to the original 100 parts.

Q. On an absolute scale?

A. What is the 100 per cent. in the case of the river water; how much did the river water originally contain?

Q. What I have in mind is that Exhibit No. 177 provides for the reduction by purification or partial purification of the putrescible matter at least 10 per cent. on an absolute scale. Now, I want to know whether the results guaranteed in the effluent can be produced, if the putrescible matter is reduced only 10 per cent.?

A. I hardly feel able to predict. My impression is they would not be reached.

Q. At what stage of purification of putrescible matter do you think those results will be reached?

A. Assuming that it will be possible to identify it?

Q. Of course?

A. I do not know why, of course, because the guarantee distinctly attaches it to the sewage which comes from New Jersey. It does not say sewage in general.

Q. I am not referring to the New Jersey stipulation exclusively. I am drawing your attention to both of the stipulations as a matter of fact, as they are both substantially the same as to the guaranteed results, and I want to know whether in either case the results guaranteed in your judgment can be obtained, by reducing the putrescible matter by partial purification 10 per cent.

Mr. O'Sullivan: I object to this whole line of re-cross examination, as not pertaining to any matter touched upon or inquired into on the redirect.

The Commissioner: Note the objection of Counsel for Complainants.

3101 A. My belief is, it cannot.

Q. Then, what reduction in putrescible matter by purification, in your judgment, will be necessary to produce the guaranteed results.

A. That I cannot say. I cannot determine what per cent would accomplish it.

Q. Do you think 20 per cent. would?

A. 20 per cent. would come nearer than 10 per cent. decidedly.

Q. And 21 would be a little nearer than 20?

A. Yes.

Q. Do you think that 20 would be enough to produce it?

A. You are taking me into a field so uncertain that I hesitate to form, much less to express an opinion on it.

Q. Why is the field uncertain?

A. Because of the extreme difficulty of evaluating the numbers, the disturbing factors which enter into it.

Q. Any difficulty in determining whether turbidity is produced by the effluent?

A. I can readily imagine, or in fact could suggest a plant or process, by which you could remove the turbidity.

Q. I understand that, but take the effluent which has come from a purification plant, which has removed 10 per cent. of the putrescible matter, cannot you easily arrange a demonstration which will show whether that effluent will produce turbidity in river water of the character of the Hudson River at the Bronx Sewer?

A. Well, my answer concerning turbidity would be the same as for the others in general. I do not know whether the removal of 10 per cent. would satisfy the condition as to turbidity, although it is entirely possible to design a plant which probably would satisfy it.

Q. I was asking you whether you could take the effluent having 10 per cent. of the putrescible matter removed, and determine whether or not that actually did produce turbidity or not?

A. I think the probabilities are that there would be some turbidity remaining.

Q. Now, what about grease and color?

Mr. O'Sullivan: The same objection.

3102 The Commissioner: Note the objection of Counsel for Complainants.

A. There would almost certainly be some evidence of grease remaining, unless a larger proportion than 10 per cent. were removed.

Q. Color?

A. And possibly some color. I do not think that would be quite so certain as the grease.

Mr. O'Sullivan: I move that all that part of the recross examination which deals with effluents, grease and those other matters not covered on the redirect, be stricken from the record as not proper recross examination.

The Commissioner: Note the motion of Counsel for Complainants.

NICHOLAS S. HILL, JR., a witness called on behalf of Complainants, being first duly sworn, testified as follows:

Direct examination by Mr. O'Sullivan:

Q. What is your profession?
A. Consulting Engineer.
Q. With offices where?
A. 100 William Street.
Q. New York City?
A. New York City.
Q. Where did you graduate, Mr. Hill?
A. From Stevens Institute of Technology.
Q. In what year?
A. 1892.
Q. From 1893 to 1894, how were you occupied?
A. As engineer's secretary of the Sewerage Commission of Baltimore, Maryland, which was engaged in the preparation of plans for the general sewerage system of that city.
Q. From 1894 to 1895 how were you occupied?
A. I was engineer of the Electrical Commission at Baltimore, Maryland, in charge of the plans and construction of a municipal system of underground conduits.
Q. 1896 to 1897?
A. I was Chief Engineer of the Water Department of Maltimore, Maryland.
3103 Q. From 1898 to 1900?
A. I was practising as Consulting Engineer with offices in Baltimore, Maryland.
Q. Where were your offices?
A. In the Manufacturers Building.
Q. From 1900 to 1911?
A. Consulting Engineer, 100 William Street, New York, maintaining for the past three years Chemical and Biological Laboratory, especially fitted for the examination of water and sewers.
In addition to acting as consulting engineer in connection with the water supply of more than forty cities and towns including Norwich, Con., Norfolk, Virginia, Jersey City, New Jersey, Charleston, South Carolina, Ashland and Catlettsburg, Kentucky, and Defiance, Ohio, as well as for a number of private water companies, your engineer has been engaged in special work in New York and elsewehere.
Q. Now, coming back to 1903,—1904, how were you occupied?
A. As Chief Engineer of the Water Department of New York City made a special study of the sanitary conditions on the Croton Water, removing nuisances, preparing plans for local sewage disposal and filter plants.
Q. In 1908-1909, were your services engaged by any municipality?
A. I was engaged as an expert in charge of litigation between Jersey City and the Jersey City Water Supply Company made a complete sanitary survey of the Rockaway River (N. J.) water shed, including analysis of the river water and studies of the effects of sedimentation and currents in the Boonton Reservoir upon the quality

of the river water as well as the preparation of plans for sewage disposal works at Dover, Boonton and Hibernia, N. J., and a fifty million gallon filtration plant to be located at the Boonton Reservoir.

Q. In what states are those last named places?

A. All in New Jersey.

Q. Now, in 1909-1910, were you called upon in your professional capacity to make a sanitary survey, and if so, state where?

A. I was called upon by the Board, so called, to make a special study for water supply purposes, and in connection with that
3104 I made a complete sanitary survey and study of the Raritan Valley of New Jersey. In addition have investigated conditions along the Hackensack River, New Jersey, in connection with sewage disposal for the towns of Hackensack, Bogota and Ridgefield Park.

Q. Did that include any analyses?

A. Yes, included analyses of the river waters and a study of the pollution along the water shed.

Q. Did you do any additional work?

A. Yes, have also made sanitary investigations of the conditions about the sources of supply of every water supply in Westchester County, New York, as well as studies of the effects of the sewage of Rochester, New York, upon the water supply of the Rochester and Lake Ontario Water Company, derived from Lake Ontario.

Q. Did you do any professional work in relation to the Hackensack River?

A. Yes, as I mentioned, I have made some studies there in connection with sewage disposal for the towns of Hackensack, Bogota and Ridgefield Park.

Q. In what State?

A. New Jersey.

Q. Are you a member of any of the associations, scientific associations, to which engineers contribute membership.

A. I am a member of the American Society of Mechanical Engineers.

Q. Have you contributed to the literature of your profession in any fashion?

A. Yes, I have prepared a number of papers on topics relating to water supply and sanitary engineering.

Q. Are you familiar with New York Harbor and its tributaries?

A. I am.

Q. Have you made any study of the harbors along the Atlantic seaboard, and if so, state what studies you have made?

A. As a member of a Committee of Three, consisting of Dr. Daniel D. Jackson, Sanitary Expert, and director of the Mt. Prospect Laboratories of the Department of Water Supply of the City of New York and Mr. Theodore Horton, Chief Engineer of the New York State Department of Health, I made investigations of the Harbors along the Atlantic seaboard, including Havanna, Jacksonville, Savannah, Charleston, Baltimore, and we also made a study of the Harbor of Tampa, Florida, and in addition
3105 this committee has collected information relating to the Boston Harbor.

Q. Did you take in any rivers?

A. I forgot also to include the City of Washington, where we made a special study, and as a result of those investigations, this committee compiled a report, the work of compilation having been done in my office.

Q. What special feature of the work was done by Dr. Jackson?

A. The Committee went upon its investigations equipped with the necessary apparatus for determining the dissolved oxygen by both the Winkler and the Levy methods and for determining the salinity of the harbor waters, and the turbidity and temperatures, at the various places visited. The analytical work was done by Dr. Jackson. The observations were made by the committee jointly. They visited each of the harbors together, and the observations were divided between the different members of the committee. The results of these observations were tabulated and those results were handed over for final review in order that this data might be put in form for presentation.

Q. The data collected by the joint efforts of Dr. Jackson, Mr. Horton and yourself, what finally became of that data?

A. That was embodied in a report which I have with me and which is entitled Report upon Observations of the Pollution of Harbors of the Atlantic Seaboard.

Q. Have you got a copy of that report with you?

—. I have.

Mr. O'Sullivan: I offer in evidence the report which this witness has just now described, entitled a Report upon Observations of the Pollution of Harbors of the Atlantic Seaboard: I offer it in evidence and ask that it be marked Complainants' Exhibit No. 178.

Cross-examination by Mr. Riker:

Q. What did you do in the preparation of this report?

A. I was a member of the Committee, the Commission or Committee, which made the investigations, and the field data, which was obtained by that Committee was placed in my possession,
3106 and the tabulation of the results and the preparation of that report were in my hands up to the time of its completion.

Q. Did you obtain any of the data yourself?

A. Yes.

Q. What part of it?

A. Well, I made the readings of the turbidity at different harbors, and I was present when the samples for the determination of dissolved oxygen were made and in some cases I took the samples.

Q. Can you point out in this report the samples that you took?

A. I do not know that I could.

Q. Can you point out in this report, the determinations of turbidity, that you made personally?

A. I cannot say that I could individually. I took readings of the turbidometer possibly in Savannah, Havana, Charleston, Washington.

Q. You do not answer my questions. I am asking you this on the admissibility of this exhibit, and I ask whether you can point out the turbidity readings which you made yourself in this report?

A. I say that I do not know that I could point out the individual readings that I made, because we were working in conjunction. Sometimes two of us were taking the readings of the turbidity at the same time.

Q. What other independent original work did you do in connection with this report?

A. Well, I made the estimate of the available run-off of streams tributary to the harbors which we studied.

Q. Where did you get the data for that?

A. The data for that was obtained from the reports of the United States Geological Survey. And the United States Weather Bureau.

Q. Does that apply to Havana Harbor?

A. Not to Havana Harbor. There the estimates are based on the best available data which we could obtain locally. We consulted there the Obras Publicas and the Engineer's Office connected with the Obras Publicas and obtained such information and data as they had.

Q. What other independent original work have you done that is embodied in this report?

A. I made the estimates of the tidal pri-ms in various harbors.

Q. Where did you get the data for that?

3107 A. We obtained the data in several ways. First, we obtained it from the local engineers, the rise and fall of the tide and we also obtained it from the United States Coast and Geodetic Survey.

Q. Did you verify any information given to you by the local engineers?

A. It was checked, the information that we got from local sources was checked with information given us by the various Bureaus of the United States Government who published and disseminated that information.

Q. That is the only way you checked it?

A. That is the only way we checked it.

Mr. Riker: The offer is objected to on the ground that in the first place, it is immaterial, irrelevant and incompetent, and in the second place, in that it is not properly authenticated by production of the witnesses who are responsible for the data which is supposed to be embodied in this report, and therefore not subject to cross examination, and the statements of this witness as to the work he has done on it is merely tabulation, clerical work.

Mr. O'Sullivan: In renewing the offer of this report as part of the evidence in this case, Counsel for Complainants desires to call attention to the fact that when three men work jointly on any work of this kind, one of them necessarily has to be first.

The Commissioner: Note the objection of Counsel for Defendants. Received and marked Complainants' Exhibit No. 178.

Marked Complainants' Exhibit No. 178.

Direct examination by Mr. O'Sullivan (resumed):

Q. Mr. Hill, I hand you Complainants' Exhibit No. 178, and ask you to describe its contents in general terms?

Mr. Riker: I object to the question on the ground that the exhibit having now been offered, speaks for itself, and testimony as to its contents, is immaterial, irrelevant and incompetent.

The Commissioner: Note the objection of Counsel for Defendants.

A. The report as it is compiled, contains first a series of chapters which include a general description of the cities and har-
3108 bors visited, setting forth, the chief facts with relation to population, the extent of the sewer system, the local topography, the population contributing sewage, and like general information. With these descriptive chapters is included an outline sketch of the harbors and on those sketches is indicated the limits of the areas which were considered in estimating the sea water available for dilution, the tidal prisms, and also the areas of marked pollution. Marked visual pollution in the areas of dilution are indicated in blue, and the polluted areas or visible sewage fields, in red. These chapters also contain in some instances a general outline of the areas about the cities which were considered, or included in connection therewith.

Immediately following the descriptive chapters are found three tables, marked Tables 1, 2 and 3.

Q. Now take Table No. 1. Who prepared that table?

A. Taking Table No. 1 the information in Column 2, Drainage Area Contributing Land Water was computed in my office.

Q. By whom?

A. By an Assistant in my office under my immediate direction. The annual rainfall in inches was tabulated in like manner and the run-off was computed in the same manner, and also the fresh water flow given in Column 5 and the tidal ranges were tabulated in my office and the tidal areas considered. The data relating to the character of the harbor waters in columns 8, 9, 10 and 11, were taken by the members of the Committee during their investigations. First, the temperature of the water was in each case taken by myself, and in some cases by Mr. Horton. The salinity of the harbor waters was determined by Dr. Jackson. The turbidity was determined in each case by Mr. Horton and in some cases by myself, some also by Dr. Jackson. The dissolved oxygen determinations were made by Dr. Jackson. Turning to Table No. 2——

Q. One moment, Mr. Hill. Did you prepare data based on the result of these studies and this work and these observations?

A. I did.

Q. Is that included in Table No. 2 just mentioned?

A. Table No. 2 contains additional basic data in addition to that given in Table No. 1.

3109 Q. How about Table No. 3?

A. Table No. 3 is a summary or condensation of the data contained in Tables 1 and 2.

Q. Did you prepare charts or diagrams of these harbors?

A. Yes, as I say, with the descriptive chapter there is an outline map giving the general location and arrangement, juxtaposition, location of the town and the harbor and the surrounding waters.

Q. Will you enumerate the harbors that appear in those charts 1 to 9?

A. Harbor of Havana, Cuba, the harbor of Baltimore, Maryland, the harbor of New York City, the harbor of Washington, D. C., the harbor of Tampa, Florida, Savannah, Georgia, Charleston, South Carolina, Jacksonville, Florida, Boston, Massachusetts.

Q. Will you explain these charts or diagrams and give a brief resume of the conditions found existing at those places, also explaining the meaning of the symbols and the outlines, the general conditions?

A. The areas shaded in blue, indicate the areas considered in the extent of the total water available for the dilution of the sewage, which empties into the harbor, or portion of the harbor. The red shaded areas indicate the visible sewage fields. With relation to the conditions found in the various harbors, commencing with Havana, we find that the City covering an area of about 1,500 acres is very little above sea level. The newer city and suburbs cover about 4,500 acres. It is hilly and reaches at some points an elevation of 130 feet above mean tide. The population is 360,000. I may say that in every case the population statistics and the water available for dilution, the amount of sewage contributed, and the other items of direct importance, are all given in tabular form in tables 1, 2 and 3.

The tidal range at Havana, we found to be about one half a foot between high and low water. At the present time a complete system of sanitary sewers is being constructed for the entire city, which, when completed, will collect the sewage of the city and discharge it into the Gulf of Mexico at a point 4,000 feet east
3110 of Moro Castle in 30 feet of water. At the present time the lateral system——

Mr. Riker: Are you reading from that exhibit, simply reading from this report?

The Witness: I am simply refreshing my memory.

Mr. Riker: I object on the ground that this witness is merely reading the exhibit.

The Commissioner: Note the objection of Counsel for the Defendants.

Q. What are you doing, Mr. Hill?

A. I am refreshing my memory and summarizing the information contained in these brief descriptive chapters which accompany the maps showing the harbors in each of the cities.

Q. Confine yourself to my question and proceed.

Mr. Riker: The question is objected to on the ground that it is incompetent and irrelevant and the exhibit if properly offered speaks for itself.

The Commissioner: Note the objection of Counsel for the Defendants.

Q. You may answer my question, Mr. Hill?

A. Of the total population about 40,000 were discharging sewage through sewers at scattered points along the water front. The remainder, about 47,000 were discharging their sewage into the section of the harbor known as Atares Bay, an arm of the harbor lying at its extreme southwestern limit. Matedero Creek, St. Nicholas Creek, Dulco Creek, and other small creeks, draining a considerable portion of the suburban area of the city, empty into Atares Bay, and sewers of large size discharge into these. These creeks drained a considerable portion of the suburban area. It was in Atares Bay that our observations were chiefly made, and the conditions there were most noticeable. The data giving the results of the examinations are shown in the table on page 62 of the report.

At Baltimore, Maryland, but a small proportion of the
3111 city's population is now tributary to sewers, and a larger per cent. of this population, which is tributary to sewers enters its sewage into the northwest harbor. The tidal area of this harbor is approximately 819 acres. The details regarding this harbor are given on page 52 of the report: The conditions were found to be most objectionable, the northwest harbor being little better than an open cesspool. The volumes of water available for dilution in this harbor are given in Table 3, page 29½ as well as the amount of sewage which flows into this northwest harbor.

Mr. Riker: For my own satisfaction, I would like to know whether you propose to have this witness read this exhibit into the record?

Mr. O'Sullivan: He is not reading it in. He is condensing the various items here. There are a large number of tables, and he is condensing it.

Mr. Riker: He is reading the script from this report, are you not?

The Witness: No, I am not. In Washington, situated on the Potomac River, and at a point above which the Potomac River drains about 11,000 square miles, there are about 308,000 people contributing sewage to the general sewage system.

Mr. Riker: It is all here, every word of it.

Mr. O'Sullivan: Has he read verbatim from that?

Mr. Riker: He is reading from this exhibit. Of course if you want to take the time to have this witness read it, I cannot prevent you.

Mr. O'Sullivan: I wish it spread on the record that the page at which Mr. Riker was looking at was page 11, and that this witness has not read from page 11.

Mr. Riker: And I desire to have the record show that this witness is doing nothing more nor less than testifying directly from the supposed exhibit and selecting excerpts from it and piecing them together.

3112 The Commissioner: Note the objection of Counsel for Defendants.

Q. Go ahead, Mr. Hill?

A. Our studies in Washington were confined chiefly to study of the conditions adjacent to the outlet of the general sewerage system, consisting of two 60 inch pipes, opening vertically at a depth of about 29 feet below mean high tide.

Q. In your studies in Washington, did you take in the mean annual rainfall for the Potomac Basin?

A. Oh, yes. In each and every case in determining the amount of land water available for dilution the rainfall and runoff of the streams tributary to the harbors were studies and the results of the rainfall and run-off observations are given in the tables on pages 54, 55, 56, 57 and 58 of the report.

This is true with the exception of the harbor of Havana and the harbor of New York. In the case of Havana the amount of land water available for dilution was obtained by taking the rainfall data relating to the lower part of the State of Florida, and comparing it with the local statement of the engineers in Havana. In New York the land water available for dilution was taken directly from the figures of the Central Committee of Experts, and I believe, has been shown on an exhibit in this case.

Q. Now, for Savannah?

A. In Savannah the rainfall and run-off data used are given on page 54, and our studies were confined chiefly to the outlet of the sewer at Gordon's Wharf, which drains a large proportion of the 51 miles of sanitary sewer emptying into Savannah River at that point.

Q. Where do those appear in the exhibit?

A. Which?

Q. The matter that you have just stated?

A. In each case the Appendix No. 1, gives the foundation or basic data and explanation of the method of obtaining the land water, drainage areas tributary to the harbor considered, annual rainfall in these drainage areas, the volume of land water flow, the tidal ranges and the tidal area of the harbors considered, and the characteristics of the harbor waters, and that information is condensed and compiled in Table No. 1.

3113 Also in Appendix No. 2 of this report is given the basic data and explanation of the methods of determining the total population, the tributary population, the domestic sewage flow, the manufacturing wastes and the ground water infiltration, and the total sewage flow, all of which data is condensed and combined in Table No. 2.

Q. Does that apply for Tampa, Jacksonville and Charleston?

A. Yes.

Q. And for Boston?

A. For Boston and New York.

Q. Where does the fresh water flow appear?

A. In the table?

Q. Yes.

A. In Column 5 of Table 1.

Q. Now, how do you compute or estimate that for Havana?

Mr. Riker: The question is objected to on the ground that Havana is several thousand miles from New York, and it is manifestly incompetent and irrelevant so far as any of the conditions are concerned.

Mr. O'Sullivan: Counsel for Complainants would like to remind Counsel for Defendants that it is not quite as far as Hamburg, that he has used frequently in his cross examination.

The Commissioner: Note the objection of Counsel for Defendants.

A. If I might run through the various items.

Q. Make it as short as you can, Mr. Hill?

A. The basic data for an explanation of Table No. 1 are as follows:

The contributary land water drainage area, Column 2, in the case of each harbor was carefully computed from the best available maps.

For Havana, no reliable map was available and the statement of Mr. H. W. Hyde of the Obras Publicas, Havana, has been accepted.

For New York, the area is given as stated on Page 14 of the Central Committee's "Basic Physical Data relating to the Metropolitan and Passaic Valley Sewerage Districts."

For Baltimore and Boston, it was computed from the topographical maps of the United States Geological Survey.

For Washington, the drainage area of the Potomac River is taken as stated in a paper on "Hydrography of the Potomac Basin", Trans. Am. Soc. C. E., Vol. XXVII, Page 21 and following.

For Savannah, the drainage area of the Savannah River
3114 above Augusta was obtained from Water Supply and Irrigation Paper No. 204. Below Augusta, and above Savannah, it was computed from a State map of Georgia, published by the Georgia State Geological Survey, and the total area thus derived was checked with local estimates.

For Tampa, Jacksonville and Charleston, it has been taken from the United States Post Route map.

As previously mentioned, there is contained in Column 3 of Table 1 information relating to the mean annual rainfall obtained as follows:

For Havana, was estimated from data relating to the State of Florida obtained from the United States Weather Bureau.

For Baltimore, the value used is that given by the records of the Baltimore City Water Department.

For Washington, the mean annual rainfall for the Potomac Basin was obtained from the paper on Rainfall and Stream Flows by John C. Hoyt, Trans. Am. Soc. C. E. Vol. LIX, Page 455.

For Savannah, the figures given were taken from Table No. 4, which I now hand you, giving the rainfall and runoff in the Savannah River Basin.

The rainfall figures used in this table, as well as those in Tables Nos. 5, 6 and 7, which I now present, covering the rainfall and runoff of the basins of the Ocmulgee, Oconee, Broad, Cape Fear and

Roanoke Rivers were obtained from published reports of the United States Weather Bureau and were carefully compiled in this office.

For Tampa, Jacksonville and Charleston, values have been obtained from a careful study of the data on rainfall in the basins of comparable southern rivers shown in the Tables, 4, 5, 6 and 7.

For Boston, the figures for the Sudbury River were obtained from Table No. 8 which I now present, the figures in this Table having been carefully compiled from the records of the "Boston Metropolitan Water and Sewerage Board" and published in their reports.

In Column 5 the fresh water flow or total available runoff was obtained as follows:

3115 At Havana, was estimated from the best available data to be had and taken at one (1) second foot per square mile.

At Baltimore, in estimating the total runoff available from the basin of Jones Falls, an area sufficient to supply the quantity of water taken from the stream for water supply purposes, has been deducted from the total area of the basin, and the resulting quantity of runoff has been checked against the record of the Baltimore City Water Department of the flow of Jones Falls, from which the City obtains a portion of its water supply.

At Washington, the volume of runoff has been computed from the data presented in the paper on "Hydrology of the Potomac Basin," Trans. Am. Soc. C. E., Vol. XXVII, Page 21 et seq., and checked against gaugings of the Potomac River reported by the Superintendent of Sewers, Washington, D. C., in his report for the year 1910.

At Tampa, Charleston and Jacksonville, the runoff has been estimated by assuming 40 per cent of the rainfall as available runoff, 40 per cent being estimated from a careful study of the comparable southern rivers, data for which is shown in Tables 4 to 7.

At Savannah, the runoff was computed from the data shown in Table 4, which has been carefully compiled from gauging of the Savannah River reported in the publications of the United States Geological Survey.

At Boston, the runoff was computed from data for the Sudbury River shown in Table 8, which has been carefully compiled from the published records of gaugings made by the Boston Metropolitan water and Sewerage Board.

The tidal ranges are given in Column 6 of Table No. 1 as follows:

In Upper New York Bay was obtained from the "Report of the New York Metropolitan Sewerage Commission, 1910" page 153.

Mr. Riker: Does he know?

3116 Mr. O'Sullivan: Yes, I showed it to him.

Mr. Riker: What is the use of asking him if it is in?

Mr. O'Sullivan: I want it to appear on the record.

Mr. Riker: I do not believe that this witness knows.

Q. Proceed, Mr. Hill.

A. For Boston, from the statement of the Boston Metropolitan Water and Sewerage Board.

For Charleston, from the office of the Charleston City Engineer and for the other harbors from local sources, and checked against the

tidal range given on the United States Coast and Geodetic Survey Charts of the harbors in question.

Physical and Chemical Characteristics of the Harbor Waters as shown in Columns Nos. 8, 9, 10 and 11 of Table No. 1, are the average results compiled from Tables Nos. 9 to 16, which I now present, and which show the results of analyses of samples of the harbor waters made by D. D. Jackson and collected by your Committee, care having been taken in this case to select results which represent the normal harbor water, or water from those parts least affected by sewage pollution.

At New York, the chemical data were obtained from the report of the Metropolitan Sewerage Commission of 1910, except the putrescibility tests on mud, which were made in the laboratory of Mr. Nicholas S. Hill, Jr., upon samples collected from New York Harbor on February 8, 1912 and February 13, 1912.

The above report is in evidence as Complainants Exhibit No. 143, referred to on Page 410 to 413 and page 521 of that exhibit and the salinometer record chart in evidence as Exhibit No. 91.

Now, referring to the population data given in Column 2 of Table No. 2, the information relating to Havanna came from the Obras Publicas. For Baltimore from the United States census of 1910—that is for Baltimore, Washington, Tampa, Jacksonville and Charleston from local statements and checked against the figures of the United States census for 1910.

For New York from figures given on page 13 of Basic
3117 Physical Data Relating to the Metropolitan and Passaic Valley Sewerage Districts which is in evidence I believe in this case.

Q. Is that part of the basic physical data which you set forth in the report?

A. It is, and also comparisons of the total estimated future population contained in this exhibit, with other estimates made of the future population of New York.

Q. As compiled by Mr. Kuichling?

A. As compiled by Mr. Kuichling, and with some of the information we had in our possession.

For Boston the population was derived from figures published in the reports of the Boston Metropolitan Water and Sewerage Board of 1910 which gives the total population tributary to and contributing sewage to the three main sewerage systems there, namely, the North Metropolitan, the South Metropolitan and the Boston Main Drainage District.

In Column 3 the population contributing sewage was estimated from information obtained from Mr. H. E. Hyde of the Obras Publicas, Havana, for the City of Havana. This population was also checked by the members of the Committee.

For New York by assuming 80 per cent. of the total population as connected to sewers. That is the total population of the Metropolitan District as given by the Central Committee experts.

For Washington by assuming 90 per cent. of the total population to be tributary to sewers connected with the main sewage outfall, this

assumption being made after conference with the local Sewerage Officials as to the probable number of people who were connected with these sewers.

At Boston from the reports of the Boston Metropolitan Water and Sewerage Board for 1910, the figures being given on page 71 of the Committee's Report.

Q. Will you give the exhibit number of that?

A. Complainants' Exhibit No. 178.

3118 For Savannah, the population contributing sewage was obtained from Mr. John W. Howard, City Engineer.

Q. Of where?

A. Of Savannah.

For Jacksonville, it was from an estimate of Mr. R. N. Ellis, Superintendent of Water, Electric Light and Sewers, Jacksonville.

For Charleston from information obtained from Dr. J. M. Green, Health Officer, Mr. Dunlop of the City Engineer's office and Mr. J. M. Divan, Superintendent of the Water Company.

At 1 P. M. adjourned for Noon recess until 2 o'clock P. M.

CORPORATION COUNSEL'S OFFICE,
September 12th, 1912—2 o'clock p. m.

NICHOLAS S. HILL, JR., a witness called on behalf of Complainants, recalled for further examination, testified as follows:

Direct examination by Mr. O'Sullivan (resumed):

Q. Proceed, Mr. Hill?

A. I think when I wound up I was speaking of the population contributing sewage and the daily per capita volume of domestic sewage.

Q. For Charleston?

A. In Charleston and the principle involved in the other places listed was the same as that mentioned for the towns already given. In estimating the total volume of sewage, allowance is also made for ground water inflow, the basis for the assumptions of which are given on pages 76 and 77 of the report.

Q. Of Complainants' Exhibit No. 178?

A. Of Complainants' Exhibit No. 178.

Coming now to the sea water available for dilution the figures given for New York are those obtained from Complainants' Exhibit No. 91. In the other cities mentioned, the sea water available

3119 for dilution was obtained by the prism method, except at Washington and Savannah where the water available for dilution was considered as the total land water flow, the per cent. of sea water being so small as to be inconsiderable.

The Committee among the other tests made included tests upon the putrescibility of harbor muds, the result of which is given on page 69 and the estimates of wet sludge delivered to the harbors by the sewage are based on the data contained in the tables on pages 77, 79 and 81. Reference is made in each of these tables to the sources of information.

Q. Now, as to the putrescibility of harbor muds who made the analyses as shown in Tables 16 to 21?

A. The analyses of all of the mud, except that taken from New York Harbor, was made by Dr. Jackson, and the samples taken from New York Harbor were analyzed in the laboratory of the witness.

Q. Now, Mr. Hill, what was the object of the study of these various harbors and what bearing have the observations and the studies that are recorded in Complainants' Exhibit No. 178 upon the local problem involved in the further pollution of New York Upper Bay.

Mr. Riker: The question is objected to first, because what is the object of the investigations is irrelevant, immaterial and incompetent, and secondly that the preliminary proof has not been made, and therefore it is not competent to be the basis of any further testimony.

The Commissioner: Note the objection of Counsel for Defendants.

Q. You may proceed, Mr. Hill?

A. The investigations of the harbors were made for the purpose of establishing standards of the amount of sewage which might safely be discharged into a harbor or tidal estuary without producing putrefactive nuisance. The object of the studies was primarily to determine the conditions of the harbors visited, and express in terms of these standards the conditions which we found, for the purpose of comparing them with the conditions existing in New York Harbor, expressed in the same terms.

Q. To what standards do you refer?

3120 A. One of the standards by which the amount of permissible pollution is measured is the minimum permissible dilution of the sewage discharged, and in order that this standard may be definitely determined, it is necessary to make comparisons. The work has already been done on this line, a certain minimum dilution having been given by Stearns, Hering, Goodnough and others, but their experiments and results related chiefly to fresh water streams. The results of their findings were roughly that a stream is able to purify about one fiftieth of its volume of sewage, but not one twentieth.

Mr. Riker: I move that this last testimony be stricken out as palpably hearsay.

The Commissioner: Note the motion of Counsel for Defendants.

(Continuing:) We made estimates, as explained, of the water available for dilution in each of the harbors, and the quantity of sewage discharged into them and determined the amount of dilution in each case. As shown in Table No. 37, of Exhibit No. 178, the dilution in Atares Bay is one to eleven. In Baltimore harbor is 1 to 26, and the present dilution in New York harbor is represented as 1 to 61. The conditions in both Havana and Baltimore harbors were exceedingly bad, and indicates clearly that with a dilution as low as 1 to 26, there would be certain general nuisance.

In New York Harbor with a dilution of 1 to 61, it may be said that acute conditions have not been reached, although the harbor is

not able to perfectly digest the sewage emptying into it, and therefore, that the statement may be generally made that with a dilution of 1 to 60, with proper diversion and dispersion, there is not likely to be a general nuisance, whereas with 1 to 26, there will be and the critical point lies somewhere between the two figures.

A further means of comparison of the observation was by the dissolved oxygen in the harbors visited, and these figures were compared with the dissolved oxygen in New York harbor. The results
3121 of these tests showed that all of the dissolved oxygen in Havana harbor was exhausted. In Baltimore, the per cent of saturation was 23.4 per cent. In Upper New York Bay the per cent. of saturation is about 67. As previously stated, the conditions in Havana and Baltimore were exceedingly bad and it is probable that somewhere between 67 per cent. and 24.3 per cent. saturation, a harbor will reach a critical condition and a general nuisance will ensue.

The statements made with regard to the conditions naturally do not refer to the specific local nuisances which may occur in the vicinity of sewer outfalls. Our investigations indicated very clearly that though the amounts of dilution were much greater than the figures given, and the dissolved oxygen content of the water was higher, yet there could exist objectionable local nuisances in the vicinity of sewer outfalls, as was evidenced particularly at Jacksonville.

In addition to the examinations just mentioned, the putrescibility of the mud was taken as an additional standard or criterion of the general conditions. The harbor mud was diluted with aerated distilled water, containing nine parts per million of oxygen and tests were made to determine the amount of dilution, in which these harbor muds would putresce. The results of these tests show that in Baltimore the harbor mud will putresce in one to 830, one part of harbor mud to 830 parts of distilled water. In New York in 1 to 720, indicating that the conditions, so far as harbor mud are concerned, are at present almost as bad as those found in the northwest harbor at Baltimore. In Havana, where the conditions were worse, it required dilution of 1 to 2,200 in order to reach a condition in which the mud would not putresce. Comparing these result with the results obtained from muds from waters of known purity, as shown on page 69 of the report——

Q. Exhibit number what?

A. Exhibit No. 178. It is seen that the Massapequa Pond mud for example is not putrescible when diluted seven times. Further comparisons were made by determining as near as possible
3122 the tons of wet sludge discharged into the harbor per million cubic feet of water available for dilution. It was found that in Havana, 14.6 tons of wet sludge were discharged per million cubic feet of total water available for dilution. In Baltimore 6 tons and at the present, in New York about 3.4 tons. Our estimates were also carried forward for New York in the year 1940, assuming that the population of the Metropolitan District will be 12,000,000 at that time, and we find that the dilution will then have fallen below—will be practically the same as those which now obtain in Baltimore.

That the tons of wet sludge discharged will be slightly in excess of that now emptying into the northwest harbor of Baltimore, indicating very clearly that the conditions are fast approaching those which obtain in the Baltimore harbor.

Q. Now, what general conclusions did you draw from these investigations and comparisons with New York Bay conditions and prospective conditions?

Mr. Riker: The question is objected to as immaterial and irrelevant.

The Commissioner: Note the objection of Counsel for Defendants.

A. The basic data on which the conclusions are based, shown in Table 3, when compared, indicate very clearly the manner in which the results obtained agree. For instance, the total dilution in Havana of 1 to 11, and the harbor mud putrescibility, 1 to 2,200, and the tons of wet sludge per million cubic feet, 14.6. The dissolved oxygen is zero. These figures were naturally arrived at independently. In Baltimore, the total dilution is 1 to 26, the dissolved oxygen saturation is 23.4, the putrescibility of harbor mud is 1 to 830, and the wet sludge in tons per million cubic feet of land plus sea water is 6.

In New York harbor at present the total dilution is 1 to 61, the dissolved oxygen in upper New York Bay is about 67 per cent. The putrescibility of the mud is about 1 to 720 and the wet sludge in tons per mililon cubic feet of water available for dilution is 3.4. Following these figures across in each case it is seen that they agree, or seem to follow the same general laws, although arrived at inde-

3123 pendently.

Q. Arrived at by whom?

A. Well, the total dilution was obtained by the computations which I have already explained, based on data from the United States Weather Bureau and the United States Geological Survey and other reliable sources. The dissolved oxygen tests were made by Dr. Jackson. The putrescibility tests of the harbor muds, entirely independent tests to those for dissolved oxygen, separate and distinct, not included in the dissolved oxygen tests, were made by Dr. Jackson, and the estimates of the wet sludge were made independently in my office, based on the population data which comes from another source and upon the amount of sewage and the per capita consumption of water naturally, which comes from still another source.

Q. And each of these figures or findings that you have just described corroborate each other?

A. They do. The summary of conclusions is briefly this:

1. A general nuisance will, under ordinary conditions, result in a harbor into which sewage is emptied:

a. When the dilution approaches 1-26.

b. When the per cent of saturation with dissolved oxygen falls to 23.5.

c. When the number of tons of wet sludge per million cubic feet of total new water, available for dilution, amounts to 6.

2. A general nuisance may occur in a harbor into which sewage is emptied:

a. When the ratio of dilution falls at some point between 1-60 and 1-30.

b. When the per cent. of saturation with dissolved oxygen falls at some point between 65 and 23.5.

c. When the number of tons of wet sludge per million cubic feet of total new water, available for dilution, amounts to between 3.5 and 6.

3. A general nuisance will not occur in a harbor into which sewage is emptied under ordinary conditions:

a. When the ratio of dilution exceeds 1-60.

b. When the per cent of saturation with dissolved oxygen exceeds 65.

c. When the number of tons of wet sludge per million cubic
3124 feet of total new water, available for dilution is less than 3.5.

4. No standards or rules relating to general conditions give a basis upon which an estimate can be made of the extent to which local nuisance may occur.

5. Serious local nuisances, sensible, injurious and infectious, frequently occur where there is no general nuisance.

6. The present pollution of New York Harbor is approaching the critical point at which a general nuisance may occur.

7. If the crude sewage from the Metropolitan Sewerage District, or a large part of it, continues to be discharged into the tidal waters in the vicinity of New York, up to 1940, serious general nuisance will probably result at, or before, that time.

8. Serious local nuisances now exist in New York Harbor.

9. To discharge crude sewage from the Passaic Valley Sewerage District, in the amount proposed, and at the point selected at Robbins Reef, would create another local nuisance of wide extent and materially hasten the approach to the critical point at which a general nuisance will exist in Upper New York Bay.

Mr. Riker: I move to strike out the last testimony, on the ground that it appears by the evidence now in, that it is not intended to discharge crude sewage from the Passaic Valley sewer at that point, or at any other point in the Harbor of New York. That therefore this statement is manifestly irrelevant and immaterial.

The Commissioner: Note the motion of Counsel for Defendants.

The Witness: I may add in explanation of the findings that the basis upon which the statements relating to nuisances were made involved a definition of a nuisance which is that of a stated condition or thing which produces involuntary repugnance through the senses to a normal man, or causes injury to the property or person of a man, and we have divided nuisances for the purposes of comparison into
general and local and also into sensible nuisances which in-
3125 clude visual and olfactory nuisances and injurious nuisances which may be infectious.

Q. Mr. Hill have you made any study of the Bronx Valley sewer?

A. I have. I was employed as engineer to make an investigation and report on the Bronx Valley Sewer system.

Q. Did you make such investigation and report?

A. I did.

Q. What territory will the Bronx Valley Sewer system serve?

A. The territory served by the Bronx Valley sewer includes portions of the watershed of the Bronx River and Tibbetts Brook and portions of White Plains, Scarsdale, Bronxville and Tuckahoe, Mt. Vernon and Yonkers. The territory is shown in outline on this sheet.

Q. Where was this prepared, the chart or map that you hand me?

A. Prepared in my office.

Q. Under your direction?

A. Yes, sir.

Q. Were you connected with the Bronx Valley Sewer project at any time or in any way?

A. Not in its inception, or during construction, but as an engineer to make a report and investigation upon it after completion.

Mr. O'Sullivan: I offer the map of the Bronx Valley Trunk Sewer District, showing the sewer thereon in evidence, and ask that it be marked Complainants' Exhibit No. 179.

Cross-examination by Mr. Riker:

Q. What part of this instrument are you responsible for, Mr. Hill?

A. In what sense?

Q. Do not you understand?

A. No, I do not.

Q. What part did you do yourself personally?

A. I did not do any of the drafting personally.

Mr. Riker: I object on the ground that it is not properly proved.

The Commissioner: Note the objection of Counsel for Defendants.

Direct examination by Mr. O'Sullivan (resumed):

Q. How many assistants have you in your office?

A. They vary from 12 to 25.

Q. Do they include draftsmen?

A. They do, sir.

3126 Q. Will you describe how a draftsman completes a map such as you have just furnished here when he works under your direction in preparation of the map?

Mr. Riker: I object to it as immaterial and irrelevant.

The Commissioner: Note the objection of Counsel for Defendants.

A. The map which we here present was drawn under my direction and supervision. The basis for it is the United States Geological Survey map. This map was furnished us by the Bronx Valley Sewer Commission, giving the lines and direction of the grade of the Bronx Valley Sewer. This map having been prepared under my direction, I can vouch for as expressing in a general way the location of the sewer, by reason of having gone over the sewer, every foot of it in person, and by reason of knowing the portions and sections served. I have compared the mere tracing, the mechanical work which the draftsmen did with my knowledge of the conditions as they exist

and can say that this is a correct outline map showing in general the area served.

Mr. O'Sullivan: I renew my offer of the map just described by this evidence and ask that it be marked Complainants' Exhibit No. 179, in evidence in this case.

Mr. Riker: The objection is renewed on the same ground.

The Commissioner: Note the objection of Counsel for Defendants. Received and marked Complainants' Exhibit No. 179.

Marked Complainants' Exhibit No. 179.

Q. Do you know what population will be served by the Bronx Valley Trunk sewer project at present and what future populations if any have been computed, are likely to contribute sewage to the Bronx Valley sewer, and if so, state what they are?

Mr. Riker: I object to the question on the ground that it is indefinite, and on the further ground that it is incompetent, irrelevant and immaterial.

3127 The Commissioner: Note the objection of Counsel for Defendants.

A. The population served by the Bronx Valley Sewer in 1910 was 49,000. The estimated population to be served in 1940 is 214,188.

Q. Have you prepared any schematic expression of those figures?

A. I have prepared a table giving the past, present and estimated future population of the Bronx Valley Sewer assessment area, and of the several divisions, lying wholly or partly within the assessment area.

Q. Where was this prepared?

A. That was prepared in my office.

Q. Under whose direction?

A. Under my direction.

Mr. O'Sullivan: I offer the table showing the past, present and estimated future population of the Bronx Valley Sewerage Assessment area, produced by this witness in evidence, and ask that it be marked Complainants' Exhibit No. 180.

Mr. Riker: What part of that offer contains your own personal work?

The Witness: None.

Mr. Riker: I object to the offer on the ground that it is not properly proved.

The Commissioner: Note the objection of Counsel for defendants. Received and marked Complainants' Exhibit No. 180.

Marked Complainants' Exhibit No. 180.

Direct examination by Mr. O'Sullivan (resumed):

Q. What did you do in connection with the preparation of that table, Mr. Hill?

A. I compared this table with the census population at the dates given. I also outlined the method by which the future population was to be computed and was in touch with the Assistant in the office,

who made those computations, and was familiar with the manner in which those estimates were made. I may also say that every figure in the table was checked by a second assistant, who went over the work of the first one who did the original work on the table.

3128 Cross-examination by Mr. Riker:

Q. Did you check it personally?
A. In part, yes.
Q. How much of it?
A. I cannot say.
Q. Do you know whether the computations are correct from your own knowledge?
A. Some of them, yes.
Q. All of them?
A. No.

Mr. Riker: The objection to the offer is renewed.
The Commissioner: Note the objection of Counsel for Defendants.

Redirect examination by Mr. O'Sullivan:

Q. What is the period of flow from White Plains to the Hudson Mr. Hill?
A. About 4¼ hours when the sewer is running nearly full, and possibly 6 hours when a very small flow, such as is now passing through the sewer.
Q. Is White Plains at the head of the trunk sewer.
A. The trunk sewer runs from North White Plains through the Bronx Valley to Wakefield Avenue, Yonkers, and then turns to the west crossing under the two ridges separating the Bronx and Tibbetts Brook, Tibbetts Brook and the Hudson, and has an outlet on the Hudson River a short distance above Mt. St. Vincent station on the New York Central railroad.
Q. Do White Plains and the Hudson represent the beginning and terminal of the trunk sewer?
A. North White Plains and the Hudson, yes. The length of the sewer is 14.63 miles.
Q. What volume of sewage will be involved at the present and what in 1940 in the flow through that trunk sewer?
A. At present the volume of sewage will be, when all of the communities are connected up, about 7,500,000 gallons daily, and in 1940 we estimate that there will be 32,250,000 gallons daily.
Q. Are you familiar with the estimates made for the discharge of the Passaic Valley Trunk sewer at its outfall at Robbins Reef?
A. I am.
Q. How do the figures that you have just given in relation to the Bronx Valley trunk sewer compare with the volume to be dis-
3129 charged from the Passaic Valley trunk sewer?
A. The probable present volume of sewage from the Passaic Valley sewerage district would be 93,000,000, and in 1940 possibly 330,000,000.

Q. What amount of manufacturing wastes will the Bronx Valley trunk sewer or sewage include?
A. Little or none.

Mr. Riker: I object to that question on the ground that it is purely speculative.
The Commissioner: Note the objection of Counsel for Defendants.

Q. Are you familiar with that whole region served by the Bronx Valley trunk sewer?
A. I have been up and down the sewer from North White Plains to the Hudson, and have been in it a great many places and am thoroughly familiar with the conditions.
Q. And with the contributing area and character of the contributing area?
A. Yes.
Q. What is its character as to whether or not it is residential or manufacturing?
A. It is largely residential.
Q. Are you familiar with the territory to be served by the Passaic Valley Trunk Sewer System?
A. I am.
Q. How would you describe that as residential or manufacturing?
A. I would describe it as combined residential and manufacturing.
Q. With which predominating?
A. Well, in the actual amount of sewage discharged I imagine that the residential or domestic sewage would be greater in amount.

Mr. Riker: I move that that be stricken out as professedly mere imagination and not of any value as evidence.
The Commissioner: Note the motion of Counsel for Defendants.

A. (Continuing:) The domestic sewage will be larger in amount than the manufacturing waste, but the percentage of manufacturing wastes will be high.
Q. Can you give any estimate of the amount of manufacturing wastes that will be contributed to the Passaic Valley Trunk Sewer project?

3130 Mr. O'Sullivan: I withdraw that question.

Q. Mr. Hill, are you familiar with the oyster interests of Baltimore?
A. Not especially, no.
Q. Well, in your investigations of the conditions in Baltimore, looking to the purification and the adoption of the plans for such purification, were the oyster interests in any way considered?
A. They were very naturally considered.
Q. Is there danger of infection to oysters from the sewage?
A. There most assuredly is.
Q. Mr. Hill, I hand you Complainants' Exhibit No. 177, being stipulation between the United States of America and the People of the State of New York and the Bronx Valley Sewerage Com-

missioners and ask if you had any knowledge of or relationship to that stipulation?

A. I had knowledge of the fact that the Government and the Bronx Valley Sewerage Commission were endeavoring to come together in an agreement regarding the purification of the Bronx Valley sewage. I had no knowledge of the terms of the stipulation until they were agreed upon.

Q. Mr. Hill, will you assume that the facts and data have been proven as set forth in Complainants' Exhibits from Numbers 1 to 158 inclusive; assume that these exhibits from Numbers 1 to 158, inclusive, set forth correctly the observations, statistics, chemical analyses, bacterial determinations; photographic reproduction of places and things observed; charts and maps of contours of surface and subsurface locations; apparatus employed, together with the reports made thereon by the observers, and now in evidence in this case, have been proven. Assume, also, that the tabulations of oxygen determinations, the tabulations of bacterial count; the tables of averages for oxygen determinations, bacterial count and harbor deposits; the charts plotting float observations, oxygen percentages, bacterial count, and mud examinations, the current observations, report of tidal actions, and graphic charts thereof;
3131 current velocities, indices of sample stations and plottings thereof; microscopic examinations of harbor deposits, photographs and charts of sewage fields, dispersion areas, and sleek fields; all as set forth in Complainants' Exhibits from Numbers 1 to 158, inclusive, and such other scientific data as are included in these exhibits, are proven.

Assume, also, that the testimony which you have reviewed and which has been given by witnesses preceding you in the hearings in the present suit between the State of New York and the State of New Jersey, on all these enumerated matters, and also on the precipitation; run-off; present and prospective populations of the drainage areas, and such other scientific data as has been included in the testimony given thereon, have proven the matters therein testified to—

Taking all these facts and circumstances of record in this case, and facts observed by you and to which you have testified into your full consideration, what, in your opinion, will be the results of the contemplated discharge from the Passaic Valley Trunk Sewer outlet into New York Upper Bay, in the vicinity of Robbins Reef, on the Harbor Waters and tidal waters of New York Harbor, under present existing conditions and under prospective conditions, on or about the year 1940, and during the intervening period between the present year 1912 and the year 1940?

Mr. Riker: The question is objected to for the reasons given at the time it was propounded to the last witness to whom it was propounded.

The Commissioner: Note the objection of Counsel for Defendants.

A. In answering the question it seems to me essential to divide

the answer into two parts. First, with relation to the probable effect of the proposed outfall at Robbins Reef upon the general condition of the harbor water, and its contribution to the creation of a general nuisance, and, second, with relation to the local nuisance, involved. With reference to the first method of treatment called for under the stipulations between the United States
3132 Government and the Passaic Valley Sewerage Commission, Complainants' Exhibit No. 135, comprises screening and settling in tanks which have a capacity which shall provide for detention of an hour and a half, based on the daily average flow of sewage. In general figures this will probably mean a reduction of 50 per cent. in the suspended matter in the sewage. As a general average it may be assumed that the suspended matter carried with it about 50 per cent. of the total organic matter present in the sewage, and therefore the removal of 50 per cent. of the suspended matter means only 25 per cent. removal of the total organic matter. The deoxygenating power of sewage, due to the sedimentation, is somewhat less than indicated by the percentage removed of total organic matter, according to modern laboratory procedure, and the actual reduction in the consumption of atmospheric oxygen by the treatment of the Passaic Valley sewage will probably not exceed 15 per cent. The stipulations between the United States Government and the Bronx Valley Sewer Commission indicate that the Government experts did not expect from almost identical treatment to reduce the oxygen consumed by the effluent more than 10 per cent. If we are liberal in the matter and assume that the plant proposed for the treatment of the Passaic Valley sewage will reduce the oxygen consumed about 25 per cent. we may obtain a rough measure of the resultant effect, upon the assumption that all the sewage now entering the bay receives the same treatment. The total water available for dilution in New York harbor, Upper New York Bay, new water, is approximately 50,710,000,000 gallons per twenty-four hours, which carriers with it about 3,434,000 pounds of oxygen. The sewage delivered therein in the Metropolitan district is approximately 828,000,000 gallons per twenty-four hours, and in rough figures the average per cent. of saturation of the waters in the vicinity of New York is about 70. Therefore, the amount of oxygen at present that the sewage now consumes is about 30 per cent. or 1,030,000 pounds. Assuming that that screening, with an hour and a half sedimentation, will reduce the oxygen consumed by 25 per cent. the total oxygen consumption of the entire 828,000,000 gallons per day, treated in the same manner,
3133 will be reduced to 772,000 pounds of oxygen per day, and the percentage of saturation would then be approximately 77.5. This would probably create a satisfactory condition for the time being, but when it is considered that in 1940 the population of the Metropolitan District will have doubled, and hence that the sewage to be cared for will be more than doubled, and the organic matter to be consumed, will be more than doubled, it is seen that the oxygen content of the waters of New York Harbor will be reduced to an average of approximately 38 per cent. a figure which

very closely, if not quite, approaches the point at which a general nuisance will ensue, and hence the degree of purification prescribed is not sufficient, in my judgment, particularly when it is remembered that when the dissolved oxygen content of a harbor reaches one half the difference between the saturation value and the assumed water residual oxygen figure, one cannot draw the conclusion that the sewage contributing population may be doubled without creating a nuisance. The self purifying power of a harbor may disappear rapidly, after a certain point is reached.

With relation to the local nuisances involved, the stipulation with relation to visible suspended particles, the absence of odors and of grease and color, the absence of reduction in the dissolved oxygen content in the waters of New York Bay are inconsistent, it seems to me with the specifications regarding the processes of treatment. The specifications are so general that it is probable there will be a great variance of opinion as to what constitutes a reasonable compliance with the stipulations involved.

Mr. O'Sullivan: Your witness.

Cross-examination by Mr. Riker:

Q. In any of the cities which you visited, did you see any of the sewage treated in any way?

A. Not except in Washington, where they have a screening discharge.

Q. What kind of a screening discharge?

A. It is a coarse screen.

Q. Any sedimentation?

A. No.

Q. You have been asked a hypothetical question in which
3134 among other things you have been asked about the contemplated discharge of the Passaic Valley sewage district. What do you understand that contemplated discharge to be?

A. I understand it to be the discharge of sewage which has been treated by passing through coarse screens, grit chambers, fine screens and settling tanks, having an average detention period of an hour and a half, through an outfall sewer located at Robbins Reef, with multiple outlets, the depth of water being about I think approximately 40 feet.

Q. Do I understand you to say, Mr. Hill, that the specifications contained in Exhibit No. 135, will reduce the putrescible matter in your opinion in the sewage to the point stipulated for in the Bronx Valley stipulation?

A. Yes.

Q. Won't it reduce it below that point?

A. It might, slightly. I cannot say positively.

Q. Now why do you define the contemplated discharge as that produced by the devices and processes which you have mentioned?

A. Because of the stipulation, Complainants' Exhibit No. 135, outlined in paragraphs A and B, the method of treatment.

Q. That is the reason, is it?
A. Yes.
Q. And you do not take into account the second general paragraph of the stipulation which reads Passaic Valley Sewerage Commissioners further agree with the United States that in the operation of said sewer system at all times that following results will be secured, either through compliance with the requirements of the immediately preceding paragraphs or through requisite lawful additional arrangements?

Mr. O'Sullivan: I object to that question on the ground that it calls for a juridic interpretation of what is lawful by this witness, who has not been qualified to render any such opinion.
The Commissioner: Note the objection of Counsel for Complainants.

3135 A. Yes, I considered that in making that answer.
Q. And do you give any force to the part of that paragraph which says "Through additional lawful requisite arrangements"?

Mr. O'Sullivan: I object on the same grounds as the previous objection.
The Commissioner: Note the objection of Counsel for Complainants.

A. No, I do not give a great deal of force to that.

Mr. Riker: That is all, Mr. Hill.
Mr. O'Sullivan: That is all.

Adjourned to September 16, 1912, at 10:30 A. M.

3136 Supreme Court of the United States, October Term, 1911.

THE PEOPLE OF THE STATE OF NEW YORK, Complainants,
against
STATE OF NEW JERSEY AND PASSAIC VALLEY SEWERAGE COMMISSIONERS, Defendants.

CORPORATION COUNSEL'S OFFICE,
NEW YORK, September 16th, 1912—
10:30 o'clock A. M.

Before James D. Maher, Esq., Commissioner.

Appearances:

Dr. William J. O'Sullivan, Special Counsel for the People of the State of New York, Complainants.
Adrian Riker, Esq., of Counsel for the Passaic Valley Sewerage Commissioners, Defendants.

Met pursuant to adjournment.

DANIEL D. JACKSON a witness called on behalf of complainants, recalled for further examination, testified as follows:

Direct examination by Mr. O'Sullivan:

Q. Dr. Jackson, how familiar are you with New York Harbor waters and for what length of time?

A. I had originally worked with the New York Bay Pollution Commission and have been connected with all of the commissions up to the present one. The later commission I have had my work with. During the early part of the work I made all of the examinations of the harbor waters, which have been previously testi-
3137 fied to, and am very familiar with New York Harbor conditions.

Q. Are you still director of the Mt. Prospect Laboratories?

A. Yes, sir.

Q. I think you testified before that that was one of the largest laboratories in the world for the examination of potable waters?

A. We examine probably more waters than any other laboratory in the world. During a year somewheres between 15,000 and 18,000 samples and also we have had a very large amount of work on sewage for the Department of Public Works for Brooklyn and also for Manhattan. Sewage work is constantly going on there in connection with the various water sheds where sewage disposal plants have been installed, and at the present time, a large number of samples of Manhattan sewage are being examined for the purpose of determining their concentration and the possible treatment of these waters.

Q. In examining the samples of potable water from the various

water sheds, is it any part of your duty to examine to see if they are free of sewage pollution?

A. The examination I made both from the standpoint of the sanitary conditions which is sewage pollution, and from the standpoint of esthetic quality, physical and microscopical examinations. The most important of all, of course, being the question of sewage pollution. The examinations are very similar to those of sewage, only made in a more delicate manner.

Q. Were you engaged at any time in the examination of the harbor waters along the Atlantic seacoast in conjunction with any other man in your profession?

A. In connection with Mr. Nicholas S. Hill, Consulting Engineer, and Mr. Theodore Horton, Engineer for the New York State Board of Health, I made an examination of the harbor waters along the Atlantic seaboard with the idea of determining the general sanitary conditions of those harbors as compared with the sanitary conditions of New York Harbor. In order to get a relative line on the
3138 conditions of New York Harbor, it was necessary to make examinations of harbors which were worse and harbors which were better from the standpoint of pollution. Harbors which were found to be worse were Havana and Baltimore. The *the* harbors, found to be better, were Tampa, Jacksonville, Savannah, Charleston and Boston and Washington.

Q. What part of the joint work was done by you?

A. I made the examinations for dissolved oxygen and chlorine and assisted in the examinations for temperature and turbidity.

Q. What were those examinations for dissolved oxygen and chlorine, were they chemical, physical or what?

A. Those are chemical. The temperature and turbidity comes under the physical examination, and at the same time the other members of the party were collecting data in connection with the rain fall and runoff, the amount of sewage which entered into the harbor and the amount of dilution which that sewage got in the harbor.

Q. What methods were used by you in the chemical examinations for dissolved oxygen and chlorine?

A. I used all of the various methods, which have been employed for dissolved oxygen, with the idea of comparing the various methods, but found no great difference in the methods, and the final examinations were made by the Winkler method. In the determinations of chlorine, the volumetric method which is the standard for American Public Health Association was used, as that is the most delicate. The examination for chlorine was for the purpose of determining the amount of dilution which the sewage had with the soft water in the various harbors. In some of the harbors the dilution was entirely with fresh water.

Q. Before coming to that question of dilution, I would like to ask you some preliminary questions relative to Complainants' Exhibit No. 178, and I will ask you to state what parts of that exhibit represent your work?

A. In Table No. 1 the examinations for salinity, turbidity and

dissolved oxygen. In Table No. 3 the examinations for
3139 dissolved oxygen, putrescibility of harbor mud. The table on page 62, entitled Examination of Havana Harbor Waters. The chlorine and dissolved oxygen were done by me and the temperature and turbidity were done by my assistants.

Q. By whom?

A. By Mr. Horton and Mr. Hill with my assistance.

Q. You worked jointly?

A. We worked jointly on those tables at the top of page 63. The same holds for the examination of Baltimore Harbor water. The table on page 64 for the examination of Washington Harbor water. On page 65 for the examination of Tampa Harbor water. Page 66 for the examination of Savannah Harbor water. Page 67 for the examination of Jacksonville Harbor waters. Page 68 for the examination of Charleston Harbor water. Page 69 for the examination for the quantitive putrescibility tests for Baltimore, Havana, Savannah and the examinations of the uncontaminated mud given in Nos. 6, 7 and 8 for comparative results. That was the portion of the report that was my work.

Q. Did you confine your chemical examinations for dissolved oxygen to any one specific test, or did you employ more than one test and if so, state what?

A. I employed both the Winkler and the Levy methods, but the results were practically the same in each case.

Q. Are those recognized methods?

A. They are.

Q. Are they the standard methods recommended by the American Public Health Association?

A. They are the two standard methods which are in use.

Q. What did your investigations and examinations show relative to the comparative dilution in these harbors as compared with New York harbor?

A. It was found that the dilution of the sewage with water of the Havana Harbor was at least 1 to 11. It is probable that the dilution is considerably higher than that as there is a canal which allows considerable fresh water to be emptied into the harbor at the
upper end of Atares Bay, which was not considered in our
3140 calculations. We can therefore say that the dilution in Havana Harbor was considerably more than 1 to 11. We could get no specific data regarding this canal water.

In Baltimore the dilution was 1 to 26. In the other harbors the dilution was considerably higher. If, then, we compare the dilutions found in Havana and Baltimore with that of New York City, we have a comparison where the dilution of Baltimore of 1 to 26, which is in the northwest harbor, creates a general nuisance causing a detriment to shipping and foul odors and bubbling of the water.

Q. What does that bubbling indicate?

A. Indicating the putrescing of sewage sludge at the bottom, organic sludge. That dilution is 1 to 26, whereas the present dilution in New York Harbor has been figured as 1 to 61. We can then draw the conclusion that somewhere between the dilution of 1 to

26 and 1 to 61, there will become a general nuisance, there will be brought about a general nuisance in New York harbor, or in any other harbor. Now, if we consider the general quality of the sewage which is running into New York Harbor, the dilution of 1 to 35 will come somewhere near the point where a general nuisance will occur. But in 1940 the dilution is figured as 1 to 26 in New York Harbor. If we take these figures then as comparative evidence it will be seen that long before 1940, a general nuisance will occur in New York Harbor unless a general treatment of the sewage is resorted to.

Now, to check up the conclusions which we would draw from dilution evidence, we made a series of dissolved oxygen determinations in these harbors and we find that in Havana Harbor, the upper end of the harbor at Atares Bay, there is no dissolved oxygen at the present time, and a general nuisance exists. In the northwest harbor of Baltimore, a general nuisance exists with the dissolved oxygen 23 per cent of saturation. The present condition of New York Harbor shows a dissolved oxygen of about 67 per cent. It varies with different portions of the harbor, and with different times and seasons, lower and higher than that, but that is a fair average.

3141 If we make the same deduction for 1940, we will then have a dissolved oxygen of 35 per cent of saturation or less, and will come well within the zone where a general nuisance must of necessity exist, unless some of this sewage is removed from the harbor or an extensive treatment of the sewage is carried out.

Further checking of these estimates has been made on the putrescibility of the sewage muds at the bottom of these harbors. The mud taken by me from the bottom of Havana Harbor required 2,200 parts of water saturated with oxygen to render one part of this mud non-putrescible.

Q. What did that show?

—. It showed that one pound of mud, sewage mud, as found in the bottom of this harbor, would require the oxygen content of 2200 pounds of water in order to use up the organic material which was contained in that mud. The mud which is deposited from sewers which enter any of these harbor waters goes to the bottom and accumulates and assists in the general nuisance which may afterwards exist.

Q. How do you describe that putrescent action as to the form of microscopic life that gives rise to it?

A. The putrescence is brought about by bacterial action on organic matter out of contact with oxygen. The bacteria which are called anaerobic bacteria, or facultative anaerobic, that is the bacteria which must or may live out of contact with the air, and do not require atmospheric oxygen for their existence. They feed on the organic matter in sewage sludge, breaking down this matter into highly objectionable substances and gases.

Q. Name some one gas that is particularly objectionable as the result of their functional activity?

A. Sulphide of Hydrogen.

Q. Commonly called what?

A. Sulphuretted hydrogen, that is the common name for it I believe, which is a poisonous gas given off by these growths. Hydrogen and marsh gas, carbonic acid and other gases are also formed.

Q. Will you proceed then with your examinations of the sewage mud in Baltimore Harbor, New York Harbor and the other
3142 harbors that you examined mud in for the putrescibility?

A. I also took samples from the bottom of Baltimore harbor, samples of sewage mud from the bottom of Baltimore harbor, and found that the putrescibility of this mud was 830, considerably less than that of Havana, and showing a relative improvement over conditions in Havana.

Q. What does that 830 mean, Doctor?

A. It requires 830 parts of water saturated with oxygen to render one part of sewage mud non-putrescible, non-offensive in other words. This test is made by making the dilutions with the actual mud and water and determining the point at which some dissolved oxygen still remains in the water. The highest figures — which no dissolved oxygen remains are those at which noxious gases are given off, that is taken as the limit of putrescibility, and in this case the figure is 830.

Q. And do you find a general condition of nuisance with that proportion?

A. General condition of nuisance exists in the Northwest Harbor at Baltimore where this mud was taken.

As compared with this, an examination of the harbor mud of New York City has been made under the supervision of Mr. Hill, and so reported in this joint report.

Q. What is the exhibit number of that?

A. Complainants' Exhibit No. 178 in which the putrescibility of the mud, sewage sludge from the bottom of New York harbor was found to be 720. It will be noted that this 720 is very close to the figure of 830, which is given for Baltimore.

Q. And the 720 means what?

A. The 720 means, as in the case of Baltimore, that it would require 720 parts of water saturated with oxygen and diluted with one part of this sewage sludge to render the sludge non putrescible and free from noxious gases.

Q. What do you *inder* from that comparison of the putrescibility tests applied to the mud of Baltimore harbor, and the putrescibility test applied to the mud taken from New York Harbor?

A The putrescibility of the mud in a harbor is in a general way an indication of the amount of pollution which exists in that harbor. In those harbors where the putrescibility *or* the mud is
3143 extremely high, we have a very foul condition. If we examine the mud of streams and ponds, where no contamination exists, we get an extremely low figure of putrescibility.

Q. Showing what?

A. Showing that this putrescibility is a measure of the pollution of the water, and if we compare the 830 of Baltimore with the 720 of New York Harbor we see that the conditions in New York are very closely approaching those in Baltimore, where at the present time a general nuisance exists.

Besides using the three sets of determinations, a fourth indicator was taken on this same line, by calculations of the amount of wet sludge which entered these various harbors. It was found that in Havana the calculated amount was 14.6 per million cubic feet of water available for dilution. In Baltimore harbor it was 6.0 per million cubic feet of available water for dilution. In New York Harbor at the present time it is 3.4. Now, as before stated in Baltimore and Havana a general nuisance exists. In New York Harbor the amount of sewage sludge is more than half of that which is in Baltimore, and before 1940 the amount of sewage sludge will be more than that now in Baltimore Harbor. So that by taking all of these determinations together, we find a general check of the results which shows that considerably before 1940, with the present conditions existing as they are, and with no improvement in the treatment of sewage, we will have a general nuisance in New York Harbor, which will have a tremendous effect upon the shipping interests and the general comfort of the city.

Q. Mr. Jackson, have you been familiar with the line of work that has been done since your connection with the New York Bay Pollution Commission relative to determining the degree of pollution of these harbor waters?

A. Yes, sir. I have read the reports and talked with the men that worked there.

Q. Dr. Jackson, will you assume that the facts and data have been proved as set forth in omplainants' Exhibits from Numbers 1 to 158 inclusive; assuming that these exhibits from Numbers 1
3144 to 158 inclusive, set forth correctly the observations, statistics, chemical analyses, bacterial determinations, photographic reproductions of places and things observed; charts and maps of contours of surface and sub-surface localities, apparatus employed, together with the reports made thereon by the observers, and now in evidence in this case, have been proven. Assume, also, that the tabulations of oxygen determinations, the tabulations of bacterial count; the tables of averages for oxygen determinations, bacterial count and harbor deposits; the charts plotting float observations, oxygen percentages, bacterial count, and mud examinations; the current observations, report of tidal actions, and graphic charts thereof; current velocities, indices of sample stations and plottings thereof; microscopic examinations of harbor deposits, photographs and charts of sewage fields; dispersion areas, and sleek fields; all as set forth in Complainants' Exhibits from Numbers 1 to 158, inclusive, and such other scientific data as are included in these exhibits, are proven.

Assume, also, that the testimony which you have reviewed and which has been given by witnesses preceding you in the hearings in the present suit between the State of New York and the State of New Jersey, on all these enumerated matters, and also on the precipitation; run-off; present and prospective populations of the drainage areas, and such other scientific data as has been included in the testimony given thereon, have proven the matters therein testified to—

Taking all these facts and circumstances of record in this case, and facts observed by you, and to which you have testified into your

full consideration, what, in your opinion, will be the results of the contemplated discharge from the Passaic Valley Trunk Sewer outlet into New York Upper Bay, in the vicinity of Robbins Reef, on the Harbor Waters and tidal waters of New York Harbor, under present existing conditions and under prospective conditions, on or about the year 1940, and during the intervening period between the present year 1912 and the year 1940?

3145 Mr. Riker: The question is objected to for the same reasons that have been urged heretofore.

The Commissioner: Note the objection of Counsel for Defendants.

A. There is no question but that the Passaic Valley Sewer will add materially to the general pollution of the Harbor, to the extent of hastening the time at which a general nuisance will exist. The sewage of the Metropolitan District will have to be treated, and even with this treatment and the treatment of the Jersey sewage, there will come a time not far distant when a general condition of putrescibility of the harbor will occur. The treatment by the removal of 10 per cent. or 15 per cent. or 25 per cent. of the putrescible matter in this sewage will delay that time to the extent to which the percentage is removed, but it will only delay it, and it is possible that the City will have eventually to resort to the disposal of all its sewage at sea. That is by taking it across Brooklyn by means of raising it several times and by carrying it a distance of some 20 miles from Lower Manhattan into the ocean, where a thorough disposition of the sewage will be attained. If this is brought about for the Harbor of New York, there is no reason why New Jersey should not do the same thing.

Mr. Riker: I move that that be stricken out as not within the range of an expert's opinion. Purely gratuitous and irrelevant and immaterial.

The Commissioner: Note the objection of Counsel for Defendants.

A. (Continuing:) The Sewer Department of New York City is making extensive examinations into the quality of the sewage of Manhattan, with the idea of installing separate devices for sedimentation and screening the sewage, with the idea of calculating the cost of such devices as compared with the dilution at sea, and that data is being collected under my direction.

3146 Mr. Riker: What possible bearing has that on this case, this last part, what difference does it make what they are doing?

Mr. O'Sullivan: I think this witness has very conclusively shown that a pretty general cleaning up is absolutely necessary if we wish to avoid a general nuisance within a very short or a comparatively short time.

M. Riker: I move that this last testimony be stricken out as irrelevent and immaterial and not in response to any question.

The Commissioner: Note the objection, note the motion of Counsel for Defendants.

Q. You may proceed, Doctor?

A. By comparison with the conditions existing in the other cities, we find the dilution, dissolved oxygen, and other general conditions, better than those in New York City.

Q. Do you mean New York City or New York Harbor?

A. New York Harbor, and these figures naturally do not assist us in determining the point at which the nuisances occur, but are only comparative data as to general conditions along the Atlantic Coast. I think I have covered the general conclusions of this report.

Q. What general conclusions did you as a member of the committee reach as the result of these observations that you have described and their application to New York Harbor conditions?

A. The general conclusions have already been stated, I think. It could be re-stated in this form, that is the form of the report.

Q. Do they appear on any page of that Complainants' Exhibit No. 178?

A. The general conclusions of the committee who made these examinations are Complainants' Exhibits No. 178 on pages 51*b* and 51*c*.

Q. Are those your conclusions?

A. Those are already covered in the statements which I have made and which have been concluded by the committee.

3147 Q. Have you conducted any line of investigation to determine whether or not flies are a source or a medium of infection?

A. I have. I have been working along those lines for 6 or 7 years, and have demonstrated that wherever human fecal matter is exposed to the action of flies, that a menace to health exists, and that typhoid fever can be readily transmitted by the exposure of such fecal matter, during the season at which the flies occur. I have also made examinations of the conditions about New York Harbor and have found more or less excreta deposited along the piles where it comes from the sewers, and so naturally, wherever sewage is highly concentrated. I have also found such matter washing ashore on the beaches and being covered with maggots and flies during the fly period. Such a condition would be removed or very greatly relieved by screening and sedimentation of the sewage and this menace to health from the contagion of typhoid fever and other intestinal diseases would be thereby relieved.

Q. To what extent, Doctor?

A. It would be difficult of course to estimate how much disease is transmitted in this way, because we have in most cities large quantities of fecal matter deposited on the shore due to the lack of proper sanitary devices, which are in themselves a source of intestinal disease. No estimate has been made of the proportion which would be obtained from sewage conditions, but it is a matter of demonstration that intestinal diseases may be transmitted in this way. Naturally, the greater the concentration of the sewage in a harbor or tidal estuary, the larger the amount of deposit of such character would occur on the shore and about the wharves.

Cross-examination by Mr. Riker:

Q. Doctor, you have been asked about the contemplated discharge of the Passaic Valley sewage project. What is the contemplated discharge, as you understand it?

A. The sewers are built for 300,000,000 per day. The capacity at the start will naturally be less, but the full capacity will eventually be maintained.

3148 Q. Yes, is that all that you understand on it?

A. That answers your question does it not.

Q. I asked you whether that is all you understand to be involved in the words "contemplated discharge from the Passaic Valley Sewage project"?

A. If you put your question so that I can make out what you mean I will answer it.

Q. You have difficulty in understanding the question?

A. Yes, I have difficulty.

Q. Well, then, I will put it in a little more simple form for your advantage. What will be the character of the discharge as you understand it, from the Passaic Valley Sewerage project?

A. The character of the discharge will be a concentrated sewage which has been treated by screening and sedimentation to the extent of removing a small percentage of the putrescible matter.

Q. What percentage?

A. The greatest probable percentage that could be removed would be 15 per cent.

Q. That is your opinion is it?

A. It is. It would probably remove about 10 per cent.

Q. The probabilities are that 10 per cent. will be removed, and the largest possible amount that is to be removed will be 15 per cent. and in testifying as to the effect of this discharge, that is the character of the sewage that you have in mind, is it?

A. It would not affect the question in the least if you should make it 25, except——

Q. I did not ask you that. I asked you whether that was the character of the sewage that you had in mind?

A. It is.

Q. Perhaps if you answer my questions, we will get along better. If the same processes were applied to all the sewage discharged into New York Harbor, at what period in your opinion, will there be a general nuisance created in New York Harbor?

A. In about 1940, or possibly—well that is as near as anybody can estimate it.

Q. So that whether or not there is any treatment given to the sewage from the great City of New York, the period at which

3149 there will be a general nuisance will be about the same?

A. I have stated that the general nuisance——

Q. I do not care what you have stated. Will you answer my question?

A. I have already stated that a general nuisance will occur considerably before 1940.

Q. Well, you have stated it, why don't you answer my question. (Question repeated by the stenographer.)

A. The period at which a general nuisance will exist will naturally be delayed to the extent of the treatment which it receives.

Q. You have testified to plans for screening and sedimentation that are now under consideration. What are those plans?

—. I have not testified to any plans.

Q. Do you know what they are?

A. Do you refer to the Sewer Department or do you refer——

Q. I refer to your testimony. I refer to the fact that you testified that is under consideration for the City of New York screening and sedimentation processes which are being compared as to cost with the dilution in the ocean?

A. That is being done by the Department of Sewers.

Q. Do you know anything about them?

A. Only in a general way.

Q. And do you not know how much sedimentation is contemplated in those plans?

A. It is being considered from different points of time, depending upon the results obtained on the sewage itself. It has been found that most of the sedimentation occurs within one hour, and the plans would probably be designed along those lines.

Q. But you do not know what the plans are that are being considered?

A. The plans are for sedimentation and screening.

Q. How long sedimentation?

A. For about one hour is the probable plan which will be chosen. The matter is still under consideration. The plans are not definitely drawn. The matter is being studied.

3150 Q. How much screening, what kind of screening is under consideration?

A. That is a matter which is being studied in connection with the screening systems which have been examined, and which are being examined in this country in several places.

Q. Do they exceed in efficiency in your opinion the screening and sedimentation which are provided for in Complainants' Exhibit No. 135?

A. It is impossible to answer what efficiency such screens and sedimentation devices will have, when they are not entirely settled upon as yet as to the exact device which will occur.

Q. And you still maintain that the screening and sedimentation described in Complainants' Exhibit No. 135, if applied to all the sewage discharged into New York Bay will not postpone the period of general nuisance beyond 1940, do you?

A. I do, and I base that on actual examinations made of the sewage of the amount of putrescible matter which can be removed by laboratory experiments, on sedimentation of the actual sewage of the City and up to date, that is the only data upon which we can base a conclusion. We find that in that case about 15 per cent. of putrescible matter may be removed by sedimentation.

Q. That is the extreme amount that can be removed, is it?

A. That is the average amount.

Q. And you think authorities of the City of New York are contemplating such a system as that which will only remove the period of general nuisance to 1940?

A. It is not a question of system. It is a question of what is possible to obtain from sewage by sedimenting it. A certain amount can be sedimented and a certain amount cannot be sedimented, and you cannot sediment out by any system any more than will sediment.

Q. That is the system that the authorities of New York are considering, sedimentation and screening?

A. They are considering it, yes. They have not decided on it.

3151 Q. Now, in your prophecy of the effect of the discharge of the sewage from the Passaic Valley Sewer project, why have you not considered some other effluent than that which you have mentioned?

A. I do not get your question.

Q. Cannot you answer it?

A. I cannot answer it because I do not understand it.

Q. Do you not know that in Complainants' Exhibit No. 135 there is an effluent described?

A. May I see it?

Q. Yes. (Witness examined Exhibit No. 135)

A. You mean there is no analysis described, simply what is to be required.

Q. I am not as exact in my language as you are, Professor. I wish you would just make an allowance for that fact and answer my question as best you may. I cannot be expected to be an expert.

A. I am trying to find the exact percentage if it is stated here, which it is expected is to be removed. There is no definite statement made as to the amount here, so that no general comparison can be made. These requirements are all general in their character.

Mr. Riker: Will you read the question?

(Question repeated by the stenographer.)

A. The effluent described in this exhibit is described in a general way that there will be no visible suspended particles and no objectionable deposits and no odors of putrefaction and so on.

Q. Well, you know there is a description there, do you not?

Mr. O'Sullivan: Have you answered that last question. You said and "so on."

The Witness: There will be no injury to the public health and absence of injurious effect upon the property situated in the harbor, and absence in reduction of dissolved oxygen contents of the water of New York Harbor, resulting from a discharge of the Passaic Valley Sewer. Those things. There will be a reduction, of course, naturally.

3152 Q. Now, I am asking you whether you have that in mind when you would testify as to the effect of the discharge of the Passaic Valley sewer project?

A. I have.

Q. And you think that an effluent of that character would create a general nuisance in 1940?

A. It will add very materially to the creation of that nuisance, by adding a very large proportion of the sewage going into the harbor. The general nuisance will occur when the amount of dilution is such that no further oxygen can be obtained. Naturally if you make a large addition to that, which subtracts from the oxygen, why you are going to bring about that general nuisance at a very much shorter period.

Q. Is that the same character of effluent that you had in mind when you testified to an effluent produced by certain specific processes of screening and sedimentation?

A. It is.

Q. You do not contemplate any other processes being applied to the sewage than those that you have described?

A. To what sewage.

Q. What sewage are we talking about?

A. You will have to answer that yourself.

Q. Do not you know that we are talking about the sewage from the Passaic Valley Sewer; is not that what we have been talking about in this cross examination?

A. Will you put your question please?

Q. Do not you know what sewage I am referring to. If you do not I will say that it is the sewage from the Passaic Valley Sewerage project.

A. That was the effluent which I considered in my statement. As I understand the Passaic Valley sewage is to be treated by screening and sedimentation.

Q. I ask you whether in the effluent which you have in contemplation as coming from the Passaic Valley Sewer, whether you contemplate any other processes will be applied than those that you have testified to in the way of screening and sedimentation?

A. I think not.

Q. Why not?

A. I do not see in the evidence anywhere that any other
3153 processes which would affect the case have been considered.

Q. There are other processes are there not which are applicable to sewage and which produce a more perfect effluent than sedimentation and screening?

A. There are, yes. As I understand it the screening and sedimentation was what had been planned for the Passaic Valley Sewage. If a complete system of disposal of the sewage of Jersey City were brought about, then a considerably higher percentage would be removed, perhaps 50 per cent.

Q. Well, in your opinion, will the effluent as generally described in this Complainants' Exhibit No. 135 be produced by the processes of screening and sedimentation described in the exhibit?

A. I think there are some portions of it which will not be produced. I do not see how it is possible not to reduce the dissolved

oxygen in the water when you add a substance which is bound to take up dissolved oxygen.

Q. Do you think the processes described will produce an effluent from which there will be absence in New York Bay of visible suspended particles coming from the Passaic Valley sewage?

A. I do not.

Q. Do you think that there will be an effluent produced in which there will be an absence of deposits objectionable to the Secretary of War of the United States in the New York Bay coming from the Passaic Valley sewage?

A. I am not sure about that, I cannot state.

Q. You do not know what the Secretary of War may think, I suppose, is your trouble?

A. No.

Q. Well, do you think that in the effluent that will be produced by these processes there will be absence in New York Bay and its vicinity of odors due to the putrefaction of organic materials contained in the Passaic Valley sewage thus discharged?

A. That is a question of the local dilutions of the sewage at that point.

Q. I ask you what you think about it?

A. That depends upon the distribution beyond the point at which the sewage is purified. It is a pretty rare thing to find a
3154 sewage effluent treated or untreated which will not give locally, at the point of discharge objectionable odors, and dilution and the method of distribution will greatly relieve those things.

Q. I ask you whether in the effluent produced in the processes described in this exhibit, there will be absence in the New York Bay and its vicinity of odors due to the putrefaction of organic matters contained in the Passaic Valley sewage thus discharged?

A. In order to answer that it is necessary to state—if that sewer alone were placed into New York Bay, there might be absence of putrefactive odors except directly at the point of discharge, but with the addition of that sewage to what is already going into New York Bay, it simply serves as a contribution and brings about a time when a general nuisance will exist at a much shorter period. It is probable that when that is first added no general nuisance will occur at that point.

Q. Even if the effluent is only treated by the processes which are specifically mentioned in the stipulation, being Complainants' Exhibit No. 135?

A. That is a question of estimating as to whether a general nuisance will occur at exactly that period or a few years later. It is purely a matter of assumption. It is not possible to make a direct statement. There may be a general nuisance at that period, or it may be delayed.

Q. Direct your attention to the question of odors, and again I ask you whether the effluent as produced by the specific devices and processes mentioned in this exhibit will in your opinion produce odors due to the putrefaction in New York Bay and its vicinity?

A. It will materially add to the production of odors.

Q. Then it will produce odors in your opinion?

A. It will.

Q. I ask you whether the effluent produced by the specific processes described in exhibit No. 135, if in that there will be a practical absence on the surface of New York Bay of grease or color
3155 due to the discharge of the Passaic Valley sewage at the dispersion area or elsewhere?

A. I think the grease and color will be practically removed by such processes.

Q. So that there will then in your opinion be a practical absence on the surface of New York Bay of any grease or color, due to the discharge of the Passaic Valley sewage?

A. The grease and color will be notable in the local area at the point of discharge, as it always is, but considered from the standpoint of the entire bay, I consider there would be a practical absence due to that alone. Your question of course involves the addition of two things. There is not an entire absence at the present time of grease and color and sleek on a clear day.

Q. Well, there is an absence, is there not, of any color due to the discharge of the Passaic Valley sewage at the present time?

A. There is, yes.

Q. Now, I am asking you whether when that sewage is put in, that discharge is put in, having been treated by the processes mentioned in this exhibit, whether there will be in your opinion grease or color due to the discharge of that effluent?

A. There will be some of course.

Q. There will be?

A. There will be some. There is bound to be in the discharge of any effluent. It is only a question of amount.

Q. If there is some there will be then grease and color?

A. You are speaking about practical absence considering the greater bay or are you considering the nuisance locally? Locally there will be. If you consider the greater harbor the amount perhaps will not be material.

Q. Then there will not be, in your opinion, a practical absence on the surface of New York Bay of any grease or color due to the discharge of the Passaic Valley sewage at the dispersion area?

A. There will not, if you consider the dispersion area as
3156 the local area into which the sewage is discharged.

Q. Is that what dispersion area means, or is it not in your opinion?

A. The dispersion area of this sewage I would consider a greater distance than that.

Q. In your opinion that does not mean the point of discharge then of the sewage, is that it?

A. The dispersion area and the local area in which the local nuisance occurs may be two very different things.

Q. I want to know what you understand in general. Whether you understand it rightly or not, I do not particularly care, but I

want to know what you understand to be meant by the dispersion area when you testify as to the effluent, this discharge?

A. The dispersion area as I understand is the area affected by the sewage as it enters the harbor, brought about by tidal action and winds.

Q. Then I will ask you whether in your opinion there will be a practical absence on the surface of New York Bay of any grease or color due to the discharge of the Passaic Valley sewage at the point of discharge?

A. There will not be. There will not be a practical absence. That is all.

Q. In other words there will be grease or color coming from the discharge?

A. There certainly will be. There always is at every point of discharge. That of course becomes greatly diluted as you get away from the point of discharge.

Q. Can there be an effluent produced which will not show grease or color at the point of discharge in the harbor of New York?

A. There can be, but it is probably not practicable on a large scale.

Q. Well, from the effluent which you had in mind in your testimony as being that which will be discharged from the Passaic Valley Sewer project, in your opinion will there be any injury to the public health which will be occasioned by its discharge in the Bay of New York in the manner proposed?

A. I think that any addition to the sewage of the harbor
3157 will affect the sewage deposits which may occur on the banks or on the shore which will have a bearing on the public health.

Q. Then you think there will be an injury to the public health?

A. Yes.

Q. From that discharge?

A. Yes.

Q. Do you think that any public or private nuisance will be created from this discharge?

A. I think it will materially add to the public and private nuisance- which are bound to exist in New York harbor in the future.

Q. Do you think the effluent which you have in mind as that which will be discharged from the Passaic Valley sewage project will produce injurious effects upon the property of the United States situated in the harbor of New York?

A. It will add to it just as it does in the other cases.

Q. And do you think that by the effluent which you have in contemplation as that which will be discharged from the Passaic Valley Sewage project, the dissolved oxygen in the oxygen content of the waters of New York Bay will be reduced to such an extent as to interfere with major fish life?

A. I think in that case it will also add to it, and shorten the time at which such will occur.

Q. Well, can an effluent be produced by purification of the sewage

of the Passaic Valley by which an effluent can be produced, which will comply with the stipulations so far as general results are concerned?

A. The question of complying and not complying is purely one of percentage of the amount. Any sewage or sewage effluent will add to the coming nuisance. The amount to which it is purified will detract to that extent, from the time at which that nuisance will occur.

Q. I ask you whether there can be an effluent produced by treatment of the Passaic Valley Sewage, by which an effluent will be produced which will comply with the stipulations as to the results guaranteed?

A. There can be, yes.

3158 Q. Now, why do you assume that it will not be—why do you assume that such an effluent will not be produced as will produce the guaranteed results?

A. An effluent of that character would require something similar to that which is installed in Baltimore, being installed at the present time so far as I know. I have not heard a discussion of a plant of that character as being contemplated. That may remove perhaps 50 per cent.

Q. Such a plant is under actual construction in Baltimore, or in operation?

A. Yes, it is nearly finished. That was an extremely expensive plant and required a very large acreage also.

Q. I read from this exhibit the following words: "Second. The Passaic Valley Sewerage Commissioners further agree with the United States that in the operation of said sewer system at all times the following results will be secured either through compliance with the requirements of the immediately preceding paragraphs or through requisite lawful additional arrangements." Have you that part of the stipulation contained in exhibit No. 135 in mind?

Mr. O'Sullivan: I object to the question on the ground that it calls upon this witness to render a juridic interpretation of what is lawful for the various communities entering into this compact with the Passaic Valley trunk sewer Commissioners.

The Commissioner: Note the objection of Counsel for Complainants.

A. I have not, no.

Q. You see it before you as part of the stipulation?

A. I have not heard of it being discussed, that such an extensive plant was contemplated. I think there are no designs of any such plant, so far as I know. The designs which have been up to date made were sedimentation and screening so far as I know.

Q. And that is the reason why you conclude that that effluent will not in fact be produced, is it, because you have not heard that any such plant was contemplated as will be necessary to produce the effluent?

A. It is.

3159 Mr. Riker: That is all.

Redirect examination by Mr. O'Sullivan:

Q. Dr. Jackson, are you familiar with the probabilities of producing such an effluent as is described there?

A. I am.

Q. Would the cost be prohibitive if such an effluent was produced on a large scale in your opinion?

A. I think it would be and also the land requirements would be very extensive, and the areas would have to be a considerable distance from an inhabited region, which is a situation obtained for Baltimore, but rather difficult in this case.

Q. Are Imhoff tanks a part of the Baltimore scheme of sewage purification?

A. The tanks are plain sedimentation tanks and sprinkling filters. The effluent derived from them will be non-putrescible, and have a very large portion of the turbidity removed. In other words it will not take away from the oxygen content of the water into which it is placed.

Q. Will you distinguish between the point of discharge at the trunk sewer outfall and what you mean by the dispersion area that follows the spreading out of that same sewage discharged at the outfall?

A. In all the cities which we examined the points of discharge were usually very marked, and the water, as a rule, due to the difference in specific gravity rose suddenly from the depths in which it was placed and boiled and spread out in different directions. The point of discharge as seen in that local area would cover perhaps 15 feet or 100 feet, depending upon the amount of sewage disposal. That sewage at the local area was almost, almost invariably very evident, the odor and sleek and all the other evidences of sewages were there. But as the tides and the winds dispersed this sewage in various directions, the sewage was spread out over an area which might be called the dispersion area. That is the area in which material evidences of sewage existed. This area might be for thousands of feet in either direction, varying in direction, depending on the wind or the tide.

3160 Q. And that is what you mean by a dispersion area?

A. That is the dispersion area.

Q. In your examinations, Dr. Jackson, have you found much organic matter in solution in sewage?

A. The greater amount *or* organic matter in solution is the sewage.

Q. Is that putrescible or non-putrescible?

A. That is putrescible; generally speaking about one half of the total solids is in solution and one half in suspension. Of the one half in suspension, about one half of that will readily precipitate, say in one hour, and the amount which remains behind, which is in suspension, is more putrescible than the amount which sediments out. In other words, if the putrescibility of all the matters were the same, the amount of putrescible matter in suspension would be the same, and the amount sedimented would be equal to the amount which remained behind in suspension. But, as a matter of fact plain sedi-

mentation, instead of removing 25 per cent. of the putrescible matter which it would do if all of the matters were of the same degree of putrescibility really removes only about 15 per cent. of the putrescible matter.

Q. Is colloidal bacteria found in sewage?

A. It is.

Q. Is it putrescible?

A. Part of the colloidal matter is mineral in character and part organic. The organic portion is putrescible.

Q. Will any process of screening and sedimentation remove 85 per cent. of the organic matter in solution and in suspension in the sewage?

A. No, sir. May I modify that? That is no process of plain sedimentation, without septic action. Septic action requires from 6 *and* 8 hours and is not usually considered in large plants.

Q. Mr. Riker inquired relative to the absence of odors. What are these odors due to, these objectionable orders?

A. Odors of the decomposition of the organic matter in the sewage.

Q. Which would have escaped the screening and the sedimentation?

A. Yes, sir.

3161 Q. You described the matters that were considered by the City of New York relative to sedimentation and screening. Were there also other matters considered and advocated by those who were engaged in the consideration of taking the sewage out to sea?

A. Yes, sir. Those matters were under consideration. Estimates are being prepared to determine the relative costs.

Q. And are they under consideration yet?

A. They are.

Q. Was one of the reasons for the carrying of this sewage out to sea that by no practical method could you remove more than 15 per cent of the putrescible organic matter?

A. Yes, sir. The plain sedimentation and screening would be the same,—or practically the same as if you carried 15% of the sewage out to sea and left the other 85 behind. In every respect except the general turbid appearance. A very high degree of purification, such as is attained at Baltimore would remove say 50 per cent of the sewage. You are still putting into the bay an equivalent of 50 per cent. Therefore the removal of sewage to sea, wherever the city is within practical limits is certainly the most practical means of disposal. The cost of the entire removal to sea might readily be much greater than the cost of the partial treatment on shore, because any treatment is a partial treatment. The effluent from any sewage plant is still very highly impregnated with organic matter. I am speaking now of large plants made in a commercial way.

Q. May an effluent be free from visible suspended particles and *and* still be heavily impregnated with organic matter in solution?

A. It may.

Q. And with colloidal matter?

A. It may and it may also afterwards become putrescible.

Q. In what condition would you expect to find the sewage trans-

ported in the Passaic Valley trunk sewer, as described, as to its freshness or putrescence?

A. I would not expect it to be putrescible in character.

3162 Q. Would it be septic or fresh?

A. Septic is not fresh.

Q. I asked you would it be septic or fresh?

A. It would be comparatively fresh. That is, the time for action would not be long enough to make septic probably. There is a question of hours there.

Q. What is the character of the sewage discharged from Manhattan as to its freshness or septic character?

A. It is fresh sewage to a very large extent, very strong, and becoming putrescible shortly, within very short limits.

Q. Will the plant as described in Complainants' Exhibit No. 135 yield the results that are stipulated for in that stipulation, between the Federal Government and the State of New Jersey and the Passaic Valley Sewerage Commission?

A. I think not.

Mr. O'Sullivan: That is all.

Recross-examination by Mr. Riker:

Q. Do you think that the removal of 10 per cent. of the putrescible matter in the sewage will produce the results guaranteed there?

A. I think not.

Q. Are you familiar with exhibit No. 177?

A. In a general way, yes. I think I have read this before.

Q. Did you have any part in drafting it?

A. No direct part, no. I was consulted regarding it.

Q. Was it submitted to you before it was executed?

A. I think not.

Q. Did you know what it was to contain before it was executed?

A. I did.

Q. Do you think that effluent as described in that exhibit is impractical from a financial point of view?

A. I think not.

Q. Why not?

A. There were only two things which were possible in that state of affairs. It was impracticable to build a very large plant with sprinkling filters and devices of that character, not only expensive,

but in a situation where they would have been a decided local

3163 nuisance. There were just two things which could have been done, the one to require plain sedimentation and screening for disposal into the Hudson River; the other to carry that effluent to sea. Now, at the present time it would be impracticable to carry any of these effluents to sea, because there are no lines on which they can work. The present situation is such that the disposal of that character at this time for the Bronx was practicable and that could be expected to be brought about, from a practical point of view.

Q. Do you hear very well, Doctor?

A. I do.

Mr. Riker: Read the question please.

(The question was read by the stenographer.)

A. I think that I have answered that.

Q. You think it is not impracticable?

A. For the conditions existing in the Bronx.

Q. You think it is not impracticable to produce an effluent of that sort under the conditions existing in the Bronx, do you?

A. Exactly.

Q. Do you think that the reduction of the putrescible matter by 10 per cent. will produce an effluent of that sort?

A. I think not for any length of time.

Q. Well, what do you mean by any length of time; how long a time?

A. Well, that is discharged at a point in the Hudson River where the least amount of dissolved oxygen exists at the present time, or very near that point, and will add very materially to the poor conditions which now exist, and will shorten the time at which a general nuisance will occur and will eventually have to be replaced by some other method when the time comes for that to be brought about.

—. Well, what purification of the sewage of the Bronx will be necessary to produce the effluent which is guaranteed in the stipulations contained in exhibit No. 177?

A. This stipulation as I remember it without reading it all
3164 through requires 10 per cent. of the putrescible matter to be removed.

Q. Don't you know that the guaranteed results are the same there as they are in Complainants' Exhibit No. 135 for the Passaic Valley sewage?

A. It will carry out the removal of the required 10 per cent. of putrescible matter without question. The question of whether there will always be absence of suspended particles and sewage sleek, why the same conditions would occur. There is no question but what there would be at times considerable suspended particles coming from the sewage and sleek from such effluents. To carry out the general stipulation that 10 per cent. of the putrescible matter shall be removed, it will carry out only in a general way the physical conditions required.

Q. Did you remonstrate against this stipulation being entered into with the United States Government?

A. I was not in a position to remonstrate.

Q. You knew when it was under consideration and it came to your attention that it was not contemplated to produce the result which would produce the guaranteed results in this stipulation, did you not?

A. Your question is so involved that it is practically impossible to answer it.

Q. Do not you understand it?

A. I cannot say that I do.

Q. Very well, I will simplify it since it seems to be necessary. Did you know when this stipulation was brought to your attention

that there was no intention on the part of the State of New York of producing the effluent which is described in it?

Mr. O'Sullivan: I object to that question as it calls for this gentleman's determination of the psychic processes of an aggregate community known as the State of New York, a clear impossibility in terms.

The Commissioner: Note the objection of Counsel for complainants.

A. I did not——

Q. Why cannot you answer the question yes or no. That
3165 is the answer it calls for?

A. No.

Q. Did you know what the Bronx Valley Sewerage Commissioners proposed to install as the purification works for the Bronx sewage?

A. In a general way.

Q. What in a general way did you understand that they were going to install?

A. Sedimentation tanks and screening.

Q. Will that produce an effluent, which, when discharged into the Hudson River will produce the guaranteed results in the stipulation before you being Complainants' Exhibit No. 177?

A. In a general way.

Q. In a general way. Why will that effluent discharged in the Hudson River at the Bronx outlet produce in a general way the guaranteed results when the effluent from the Passaic Valley sewage project will not produce them in New York Bay?

A. There is a very considerable difference in the quantity of the sewage at the present time. That is taking a very small local area and comparing it with a large number of cities, the sewage being brought in in tremendous quantities. The comparison in any case is a question of dilution.

Q. Then there will be in your opinion from an effluent which represents a reduction of 10 per cent. of the putrescible matter in the Bronx Valley case, there will be absence in the Hudson River of suspended particles visible to the naked eye coming from the effluent of said sewer?

A. I do not think that there will be an entire absence. I think that that should be stated as practical absence. It is purely a question in the statement of the case. There certainly would not be an absence.

Q. And you think there will be an absence of deposits in the waters of the Hudson River coming from the effluent of said sewer, which the Secretary of War, exercising a reasonable discretion may find objectional?

A. I am not certain about that.

Q. And do you think an effluent of such a character would be obtained that there will be absence in the waters of the
3166 Hudson River and its vicinity of any odor due to the putrefaction of organic matter contained in the effluent of said

sewer, which the Secretary of War exercising a reasonable discretion, may find objectionable?

A. I think the organic matter coming from the sewer will assist in proportion to the amount going in in the general pollution of the harbor and the shortening to that extent of the time when a general nuisance will exist.

Q. And do you think there will be practical absence on the surface of the Hudson River at the dispersion area or elsewhere of any grease or color due to the discharge of said sewage?

A. I think that will be very noticeable there as a rule.

Q. You think that it will be noticeable?

A. Yes.

Q. Do you think there will be no public or private nuisance occasioned by the discharge of such sewer, meaning now the Bronx sewer?

A. I think it will contribute to a public nuisance.

Q. Do you think that the effluent from said sewer will not injuriously affect the property of the United States in the Hudson River?

A. I am not sure about that. I do not know.

Q. Did you have the same opinion when you had this stipulation before you in whatever form it was before it was executed?

A. I did.

Q. And you made no objection to it being executed on behalf of the State of New York?

A. I had nothing to do with the execution of it.

Q. How did it come to — brought to your attention?

A. Simply in a consulting way.

Mr. Riker: That is all.

Redirect examination by Mr. O'Sullivan:

Q. And as a result of your apprehensions, did you suggest that this sewage be taken out to sea, all the sewage?

A. I have, but that of course must necessarily be a general proposition, as no one single small community could afford to do it.

3167 The Bronx Valley sewer as arranged for at present is the only possible arrangement which can be made until some general system of disposal is brought about.

Q. Dr. Jackson, I hand you Complainants' Exhibit No. 135 and Complainants' Exhibit No. 177 and ask you if there is any plant described in Complainants' Exhibit No. 177 which is assumed to give the results?

A. The plant described is screening and plain sedimentation, which shall purify the same to the extent of 10 per cent upon an absolute putrescible scale.

Q. Has any plant been determined on so far as you know?

A. No exact plant.

Q. Do you believe that any plant can be produced that will give the results stipulated?

A. Plain screening and sedimentation will remove 10 per cent

of the putrescibility required on this scale, but it will not create a condition where absence of suspended particles and absence of deposits or odor or the increase in deposits from such sewage will not exist. Those terms are not intended to be absolute I imagine, if they are so expressed.

Q. Is there a plant described in Complainants' Exhibit No. 135 for the production of the effluent guaranteed?

A. No plant is described but merely a general process, as in the case of the Bronx Valley sewer of mechanical screens and sedimentation.

Q. Will that yield the effluent stipulated in that compact or stipulation, these general processes that are described there?

A. That will yield an effluent similar to that described in the Bronx Valley case. The difference will be in the amount of dilution.

Q. What difference is there as to the character of the sewage of the two trunk sewers, the one for the Bronx Valley and the one for the Passaic Valley, as to its residential or trade waste character?

A. It is pretty difficult to determine until the sewage is actually analyzed in both cases, which has not been done. But generally speaking there naturally would be more trade waste in the

3168 Passaic Valley.

Q. Are you familiar with the region to be served by the Bronx Valley trunk sewer?

A. In a general way. It is practically house sewage.

Q. Entirely?

A. Almost entirely so.

Q. And how as to the Passaic Valley sewage, the character of the community to be served by the trunk sewer project of the Passaic Valley Sewerage Commissioners?

A. That would naturally be mixed with a considerable amount of manufacturing waste.

Q. Now, as to the population of the two regions to be served by these two trunk sewers, how do they compare?

A. The Bronx Valley is very much smaller and the dilution of the effluent would be to that extent greater.

Mr. O'Sullivan: That is all.

Recross-examination by Mr. Riker:

Q. How do these two stipulations differ?

A. I do not think there is anything in this stipulation which requires 10 per sent. of the putrescible matter to be removed, but by the process the 10 per cent. probably would be removed.

Q. In any essential features do they differ in your opinion.

A. No, not essentially.

Mr. Riker: That is all.

The witness: Except in quantity.

Q. The stipulation does not consider the quantities, does it?

A. No.

Mr. O'Sullivan: Is it easier to treat sewage in a large quantity or a small quantity with a view to getting the effluent stipulated for in the two stipulations?

A. The larger the amount of sewage to be treated the less favorable will be the results always.

At 1 P. M. adjourned for noon recess until 2 P. M.

3169 CORPORATION COUNSEL'S OFFICE,
NEW YORK CITY, September 16, 1912—
2 o'clock P. M.

ANDREW J. PROVOST, Jr., a witness called on behalf of Complainants, recalled for further examination testifies as follows:

Direct examination by Mr. O'Sullivan:

Q. Mr. Provost will you state what familiarity you have with the harbor of New York and the harbor conditions here?

A. My experience with the harbor of New York dates over a period of about 20 years. Previous to serving as a member of the Metropolitan Sewerage Commission I was employed by the City of Brooklyn and afterwards by the City of New York as Engineer in charge of design and construction of sewers and sewer outlets and I was subsequently consulting engineer for the City of New York in the construction of many of the large outlet sewers, principally in the Boroughs of Brooklyn and Queens. In my studies of the design of sewage systems for the City and Borough of Brooklyn, which began about 1895, I paid especial attention to some of the largest outfall sewers, which were built in that territory, particularly those located in the area south of the backbone of Long Island, south of Prospect Park, and taking in the sections of Bay Ridge, Flatbush, Flatlands and Gravesend. These territories were very large some of the outlet sewers draining territory of three and four and five thousand acres; some of the largest sewers in the City of New York were subsequently constructed for the relief of these territories, with outlet sewers in the Upper Bay and Gravesend Bay and in Jamaica Bay. That portion of my work which related to design covered also a study of the lateral tidal currents along the Brooklyn shore in the neighborhood of the proposed sewer outlets, the principal consideration being as to the direction which the sewage would take in the tidal streams after it was discharged
3170 and where it would ultimately go. My studies with respect to the conditions at sewer outlets in regard to visible pollution were chiefly in relation to the reconstruction of the old sewer outlets in the City, notably those at the foot Quay — Street, Feugeron Street, North Second Street, at the foot of Fulton Street, at the foot of Hamilton Avenue, and at the foot of Forty-third Street. I had charge also of some of the dredging work which was done there about the piers which — near the large sewer outlets. Subsequently I made a great many trips to the waters of the harbor, particularly after I became a member of the Metropolitan Sewerage Commission and I observed the evidences of pollution in and about

all parts of the harbor for several years, both before and after being a member of the commission.

I think that covers as nearly as I can recall it, my experience with the harbor waters:

Q. Were any float observations conducted under your personal *supervation* during your connection as a member of the Metropolitan Sewerage Commission?

A. There were. I have already testified I think to 26 separate float experiments which were conducted under my direction and supervision.

Q. Did any of those extend in the lower Bay?

A. Yes, quite a number of them extended down to the Lower Bay beyond Coney Island and down almost to Sandy Hook.

Q. And from the float observations that you have just now testified to, what would you say as to the tides or the backing up of sewage against the Staten Island shore?

A. I should say that the results of these float experiments, taken together with the results of observations in Gravesend Bay and observations on the ocean side of Sandy Hook Neck, have satisfied me that there is a prevailing southerly current running the greater part of the time along the Brooklyn shore of Gravesend Bay.

3171 That there is a prevailing northerly current running along the ocean side of Sandy Hook Neck. That the prevailing strength of the flood tide, as it leaves the upper end is toward and along the Coney Island shore, and that the prevailing strength of the first flood tide, as it comes into the ocean channels, is toward the south shore of Staten Island and into Princess Bay.

Q. Have you noted what effect these currents have on the sewage coming on the ebb?

A. Yes, I have noticed evidence of sewage floating in with those currents in the directions that I have stated.

Q. What effect has it on the sewage coming down from the Upper Bay on the ebb?

A. The effect of the ebb tide on the sewage coming down from the Upper Bay is for the most part toward the Coney Island point, but not into Gravesend Bay.

Q. Where does the other part go?

A. You mean of the flood?

Q. Of the sewage?

A. The sewage follows the strength of the ebb tide very largely.

Q. In what direction?

A. That is a general southeasterly direction.

Q. Have you had any experience in building sewers?

A. Yes I have built a great many sewers. Some of the largest sewers that have been built in the City of New York have been built under my direction, with my assistance.

Q. Now, as to the point of discharge in relation to the body of water into which the sewage is discharged, does it make any material difference whether it is discharged some distance below the surface or a great distance below the surface as to its ultimate destination?

A. Domestic sewage discharged into salt tidal waters irrespective of the depth at which it is discharged, will rise to the sur-
3172 face of the tidal stream. The time required for it to rise will depend somewhat upon the depth at which it is discharged, but its ultimate destination is the surface of the tidal stream.

Q. Do you know of any trunk outfall that is discharged at some depth from the surface of the water, some considerable depth?

A. All the sewers which have been built by the City of New York, to which I have just testified, discharge at either about low water or at an elevation not greater than 7 or 8 feet below water. I have observed sewers in other cities where the outfall is considerably lower than this in the tidal stream.

Q. What depth, do you know, if you do know; is the outfall of the sewer to be discharged at Robbins Reef as proposed by the Passaic Valley Trunk Sewer Commission?

A. I understand that the depth of that sewer is contemplated at 40 feet below high tide.

Q. Do you know of any trunk outfall that approximately discharges in the neighborhood of that depth?

A. There is one in the harbor of Boston, about that depth.

Q. Have you examined it?

A. I have.

Q. When?

A. In December 1911.

Q. Now, will you state what your examination consisted in and how you made it?

A. The examination of that outlet was a part of an investigation which I made of all the sewage outlets from the City of Boston and the surrounding Metropolitan Territory, which had for its purpose the examination of the visible effects of Pollution on the surface of the harbor from the discharge of sewage in large quantities, either at the surface or at various depressed distances below the surface.

On December 4th, 1911, I went to Boston for the purpose of making these observations. On December 5th I visited and carefully examined the calf pasture pumping station, which was constructed by the City of Boston about 20 years ago. On this trip I was accompanied by Mr. Donlin, of the Boston Department of Health
and by Dr. Pease of New York City, Dr. Herbert L. Pease.
3173 This pumping station receives all of the sewage from a relatively densely populated area of about 1,000 acres, comprising all of the low lying territory south of the Charles River. This sewage amounts on the average to about 95,000,000 gallons per day, and is pumped by the machinery in this pumping station through a tunnel located Dorchester Bay to Moon Island, where the sewage is stored in masonry tanks until the strong ebb of the current when it is discharged into the waters of the outer harbor, which I shall presently describe. The principal pumping machinery consists of a large beam and fly wheel engine of the Leavitt type, installed about 20 years ago. A new centrifugal pumping unit was being installed

at the time of my visit. This pumping station and the outfall works at Moon Island are a part of the main drainage system and are operated by the Boston City Department of Public Works. Near the pumping station there is a small experimental sewage treatment plant, taking sewage from the station. This plant is operated by the Massachusetts Institute of Technology, and was visited and examined by me at the time of the above visit; on December 6th, in company with Dr. Crawford, Quarantine Officer for the Boston City Health Department, I proceeded on board the Quarantine boat, the Vigilant, to Deer Island, where I examined the pumping station which receives all of the sewage, amounting on the average to about 60 million gallons per day from the North Metropolitan District, which comprises an area of about 90 square miles, and has a tributary population of about one half a million. This station has been in operation for about 12 years. The pumping equipment consists of four submerged centrifugal pumps of the Allis Chalmers type driven by triple expansion steam engines. These pumps lift the sewage and discharge it continuously through a 72 inch outfall into the harbor water at about low tide level or ten feet below high tide level, near a reef south of Deer Island. Some attempt is made to intercept
3174 solids by screening before the sewage has passed through the pumps but the amount so intercepted appears to be insignificant. Observations made by me at this time showed that the material so intercepted and recovered from about two million gallons of sewage did not exceed about 1½ cubic feet or the contents of an ordinary bushel basket. The material recovered appears to be chiefly paper. I then proceeded on the Quarantine steamer to the point in the harbor where the sewage from the Deer Island Pumping station was discharged from a single outlet. The tide was then about high, and the point of discharge about 9 or 10 feet below the surface. From the upper deck of the Vigilant I observed a distinct area of discoloration about the outlet and extending westerly toward Boston of about approximately forty acres. A large number of gulls were hovering over the outlet and over the discolored area. A distinct disagreeable odor was present when the boat was in or near the sewage field. I then returned to Deer Island to meet Mr. Frederick D. Smith, Division Engineer in charge of Maintenance and Construction of the South Metropolitan System, with whom I then proceeded by the steamer Vigilant to the two outlets forming the Nut Island outfall of the South Metropolitan system. This sewage district comprises about one hundred square miles with a population of about 350,000. Most of the sewers in this district are high enough to permit their discharge by gravity to the Nut Island Screen house. The amount of sewage passing through the screen house is about 40 million gallons per day, average flow. This sewage is discharged continuously into the harbor by two divergent lines of 60 inch pipes, which terminate in about 30 feet of water below tide, and are perhaps about one half mile apart. They are about two miles down east from the Moon Island outfall. At the time of my inspection of these outfalls, the tide was just turning ebb. Evidence of sewage upon the surface of the

water at the two points of discharge was notably less than at
3175 the Deer Island outlet. This difference I attributed to the relatively smaller amount of sewage discharged at each outlet and to the greater dilution due to the increased submergence of the outlets. The amount of discharge 20 million gallons per day, from each outlet does not exceed that from several outlet sewers in the Borough of Brooklyn, New York City, notably those at the foot of South Fifth Street, Division Avenue, Little Street, 43rd Street, and so forth. Before making this trip I had anticipated the need for Mr. Smith's help in locating these outfalls for the reason that they are in deep water and at least a mile from Nut Island, but soon after leaving Deer Island, there were observed two large flocks of gulls such as had been observed at the Deer Island outfall, and these were found to hover continuously above the respective outlets, as later identified by Mr. Smith and by the visible evidences of sewage on the surface of the water. I then proceeded with Dr. Crawford on the Quarantine Boat to Moon Island outfall, arriving there about one hour after strong current of the ebb tide, and just as the outlet gates from the reservoirs were opened to release the 40 odd million gallons of sewage which had been stored therein during the flood and the weak ebb tides. The outlet consists of a series of parallel pipes discharging close together at about the surface of the harbor water. The discharge takes place in about four hours on each side, and there is an appreciable seaward velocity given to the tidal stream when the flow occurs. Immediately after the discharge begins, there is noticeable an excessive discoloration of the harbor water in the vicinity of the outfall and the presence of pronounced putrid odors. Gulls in large quantities immediately approach the spot from all directions and follow the stream of sewage as it progresses rapidly seaward. After observing these conditions for a short time, I visited the storage tanks and the gate house on
Moon Island and thereafter proceeded by the steamer Vigi-
3176 lant to observe the nature and extent of the visible evidences of the discharge of sewage upon the surface of the harbor water. I followed and observed the discolored stream for a distance of about two miles, both to the east and to the west of Long Island, and satisfied myself that the former stream evidently commingled with the sewage discharged at Nut Island, while the latter joined the sewage discharged from Deer Island. From the upper deck of the Vigilant I could observe a sewage stained area of harbor within my vision, which I estimated to cover at least 600 acres.

Summarizing my observations of December 6th, 1911, I would say that I observed sewage disposal by tidal dilutions in Boston Harbor as continuously discharged from three submerged outlets at the rate of from 20 million to 60 million gallons per day at each outlet and the concentrated discharge of stored sewage at the rate of about 11 million gallons per hour from one surface outlet and that as a result of these observations I am of the opinion that the methods of disposal observed constitute a nuisance during the winter season and they must necessarily be worse during the sum-

mer season. Dr. Crawford stated in my presence, in the presence of Engineer Smith——

Mr. O'Sullivan: You need not mind that, Mr. Provost.

Q. What was the date of these observations, give the year?
A. The dates were December 5th and 6th, 1911.
Q. Mr. Provost from your knowledge gathered from observations and occasional services rendered in the waters of New York harbor and from your observations made at submerged sewer outfalls in other waters, what in your opinion will be the result of the contemplated discharge from the Passaic Valley Trunk sewer outfall at Robbins Reef, taking into consideration the quantity and age of the sewage?

3177 Mr. Riker: The question is objected to as it does not appear on what facts the witness is asked to express an opinion.
The Commissioner: Note the objection of Counsel for Defendants.

A. From my observations carried on over the period of time mentioned, I have formed the opinion, that the waters of New York Harbor are continually, constantly becoming more polluted and that from the present state of the waters, as I have noted, I believe that the discharge of large quantities of sewage, such as is represented to be discharged as proposed form the Passaic Valley Trunk Sewer, under the conditions as they have been stated, and from my observations of somewhat similar discharges in the City of Boston and other places that such discharge would constitute a nuisance in the Harbor of New York.

Mr. O'Sullivan: Your witness.

Cross-examination by Mr. Riker:

Q. By harbor do you mean the most widely extended view of the waters, including Newark Bay and Gowanus Canal and Newtown Creek and Gravesend Bay?
A. I should include the general area of the Upper Harbor in that statement.
Q. You think there would be a nuisance if it was discharged into Newtown Creek?
A. There is a nuisance there.
Q. I say if the sewage in question were discharged into Newtown Creek, do you think it would constitute a nuisance there?
A. I do, yes.
Q. You think those conditions would be made worse than they are, do you?
A. Yes, they could be made worse.
Q. In what respect might they be worse?
A. They are getting worse I think every year and there might be a limit of nuisance, but it is hard to define it.
Q. What is the largest sewer that you ever constructed for the City of New York, Mr. Provost?